Railway Mechanical Engineer

FOUNDED IN 1832

as the American Rail-Road Journal, with which are also incorporated the National Car Builder, American Engineer and Railroad Journal, Railway Master Mechanic, and Boiler Maker & Plate Fabricator. Name Registered, U. S. Patent Office

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* Illustrated article; § editorial; † short, non-illustrated article or note; ‡ communication.

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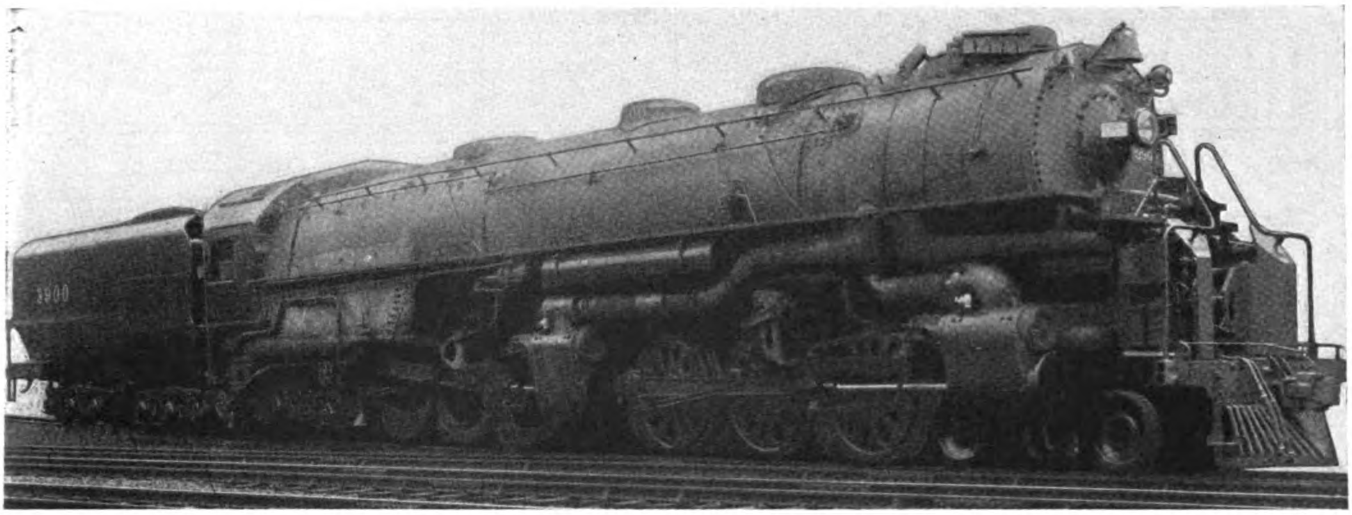
RAILWAY MECHANICAL ENGINEER



The Union Pacific 4-6-6-4 freight locomotive

Union Pacific

High-Speed Freight Locomotive

American builds 4-6-6-4 type which weighs 566,000 lb. and develops 97,400 lb. tractive force—Front frame construction and articulation incorporate unusual features

FIFTEEN single-expansion articulated freight locomotives were delivered to the Union Pacific by the American Locomotive Company during the late summer and early fall. These locomotives, which are of the 4-6-6-4 type, develop a starting tractive force of 97,400 lb. They have a total engine weight of 566,000 lb., of which 386,000 lb. is on the drivers. The driving wheels are 69 in. in diameter and the four cylinders are 22 in. by 32 in. The boilers, which carry a working pressure of 255 lb., have a combined heating surface of 7,031 sq. ft. and have a grate area of 108.2 sq. ft.

The Boiler

The boiler is conical in form, with an inside diameter at the first course of 96 11/16 in. and an outside diameter at the third course of 102 in. The barrel courses are of silico-manganese steel. The firebox is of larger size than is indicated by the grate area. A Gaines arch is installed with a brick wall across the firebox 5 ft. 9 in. back of the front throat sheet, thus adding to the volume of the combustion chamber which extends 86 in. from the throat sheet into the barrel of the boiler. There are five 4-in. arch tubes. The firebox is designed with a horizontal mud ring and fuel is burned on Firebar grates, fed by a Standard Type BK stoker.

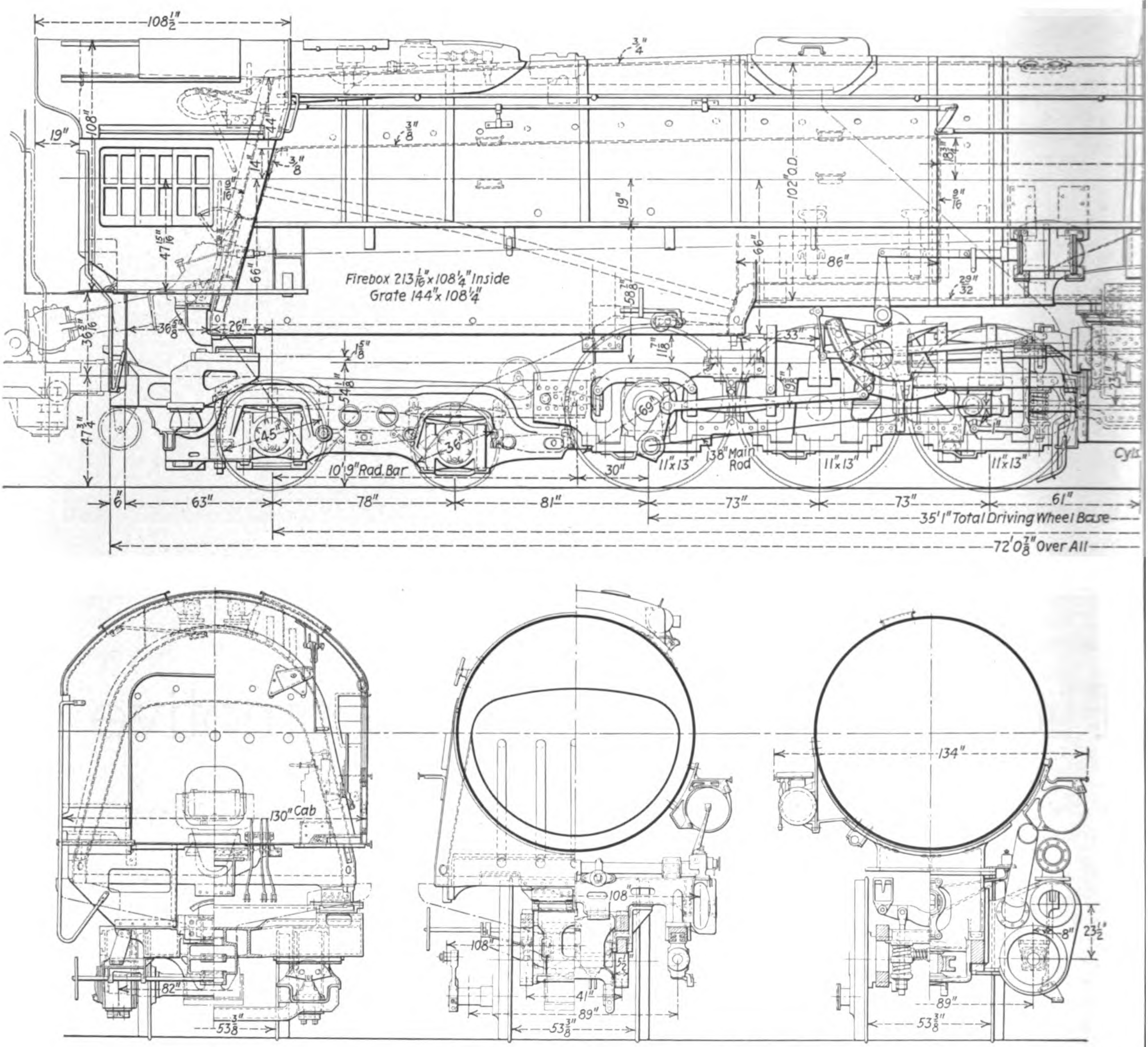
Owing to their size the side and crown sheets are separate and are joined by welding. The inside throat sheet and combustion chamber are also welded into the crown and side sheets. In addition to the Flannery flexible staybolts across the top corners of the side sheets flexible radial stays are applied on the four outside rows on each side of the firebox and combustion chamber, and the adjoining top three rows of staybolts are also flexible. Both the rigid and flexible staybolts, as well as the flexible radial stays, are of Lewis iron. The tapered-end radial stays are of special Ulster iron.

Seal welding is employed on both the inside and outside sheets at the mud-ring corners and at the junctions of the longitudinal and circumferential barrel-course joints, according to the builder's practice. The turret dry pipes extending back from the dome are welded into the turret flange of the roof sheet, and the clamps securing the pipe inside the boiler are welded to the clamp supports, thus providing a permanent installation.

The tube sheets are laid out for the type A superheater. The header is fitted for the American type front-end throttle. Ten of the locomotives are fitted with Worthington No. 6-SA feedwater heaters. The remaining five have Sellers Type S non-lifting exhaust steam injectors.

The Frame Structure

The frames are of the cast-steel bar type. Those of the rear unit are joined at the rear to the cradle casting



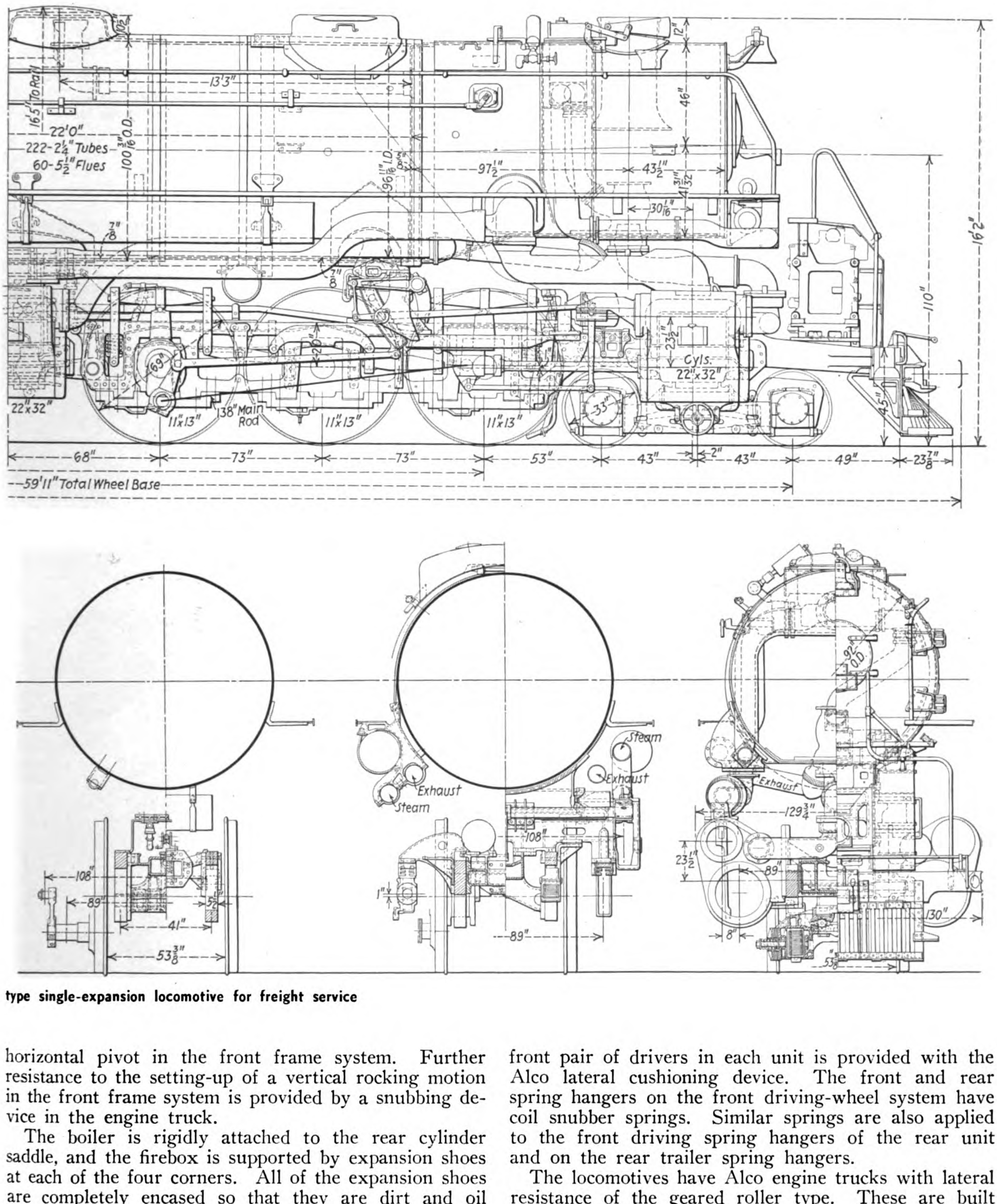
Cross-sections and elevation of the Union Pacific 4-6-6-4

and at the front end to the combined cylinder-saddle and articulation casting. The usual type of cross-bracing is employed.

On the front unit, which has no rigid attachment to the boiler, a unique system of bracing and torsional stiffening has been applied. The front ends of these frames are bolted and keyed to a combined cylinder-saddle and front deck casting. Bolting pads are provided on the sides of this casting for the cylinders. A box section of this casting extends back from the saddle portion approximately to the front pedestal. The rear end of this casting terminates in a transverse vertical bolting flange, to which is bolted a long box-section casting which extends back between the frames. From this project suitable bolting pads for attachment to the inside faces of the vertical members of the frames. At the articulation casting between the rear ends of the frames transverse bolting flanges again provide for a rigid connection between the two castings. Pads are provided on top of the backbone casting for attachment of the single boiler support.

The articulation hinge is pivoted horizontally in the rear end of the front articulation casting. It is ball connected to the vertical hinge pin in the rear engine unit. This provides for free adjustment of the two engines to vertical track curvature, with the front boiler support as the pivot about which the vertical angular movement of the front frame system takes place.

The pivoted hinge is cast with a vertical bell crank arm to which is attached a stabilizer to prevent possible synchronous oscillations of the front frame system. The stabilizer consists of a wide horizontal bar extending forward along the center line of the front engine. This bar passes between horizontal white fibre friction surfaces which exert a predetermined resistance to the longitudinal movement of the bar under load of three inner coils from Class G springs and thus prevent the free oscillation of the articulation tongue about its



type single-expansion locomotive for freight service

horizontal pivot in the front frame system. Further resistance to the setting-up of a vertical rocking motion in the front frame system is provided by a snubbing device in the engine truck.

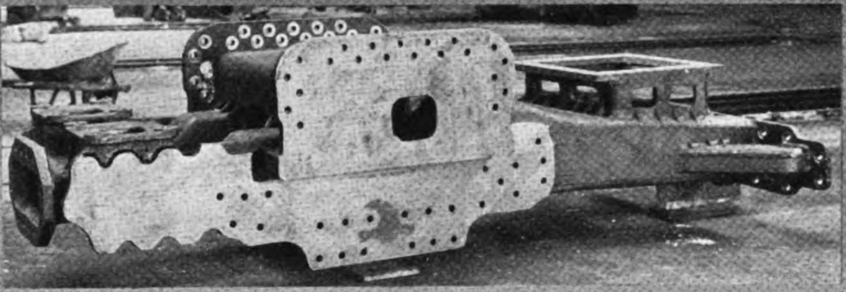
The boiler is rigidly attached to the rear cylinder saddle, and the firebox is supported by expansion shoes at each of the four corners. All of the expansion shoes are completely encased so that they are dirt and oil tight.

An unusual detail of the frame construction is the fitting of the pedestal caps metal to metal against the frames. The pedestal toes are extra heavy.

Running Gear

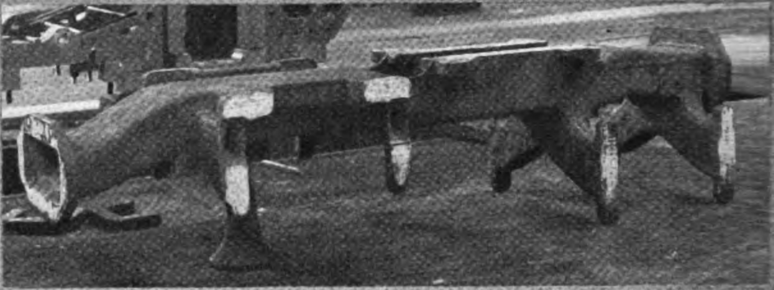
The driving wheels are the Alco Boxpok type, and the main drivers, only, are cross-counterbalanced on each unit. The driving axles are fitted with crown bearing boxes and with Franklin grease collars. The front pair of drivers in each unit is provided with the Alco lateral cushioning device. The front and rear spring hangers on the front driving-wheel system have coil snubber springs. Similar springs are also applied to the front driving spring hangers of the rear unit and on the rear trailer spring hangers.

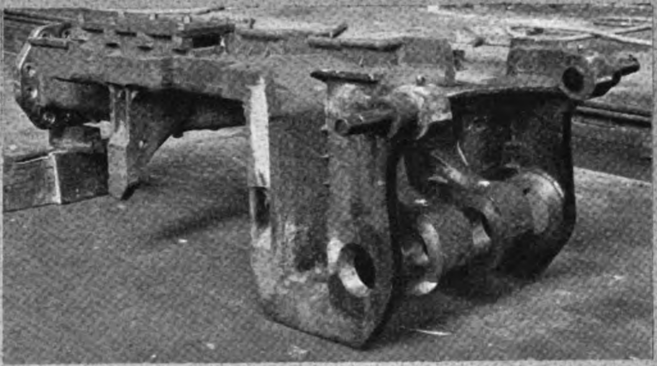
The locomotives have Alco engine trucks with lateral resistance of the geared roller type. These are built with a low initial resistance gradually building up to a higher resistance which becomes constant after about 1 in. of lateral movement. The vertical damping device which is built into each side of the engine truck consists of fibre discs mounted on a horizontal spindle at each side of the truck frame. Between the fibre discs are two rotating metal plates, projecting from each of which is a tongue by which it is connected to the end of the bolster, by linkage. The links are on opposite sides of the spindle about which the plates rotate. Any



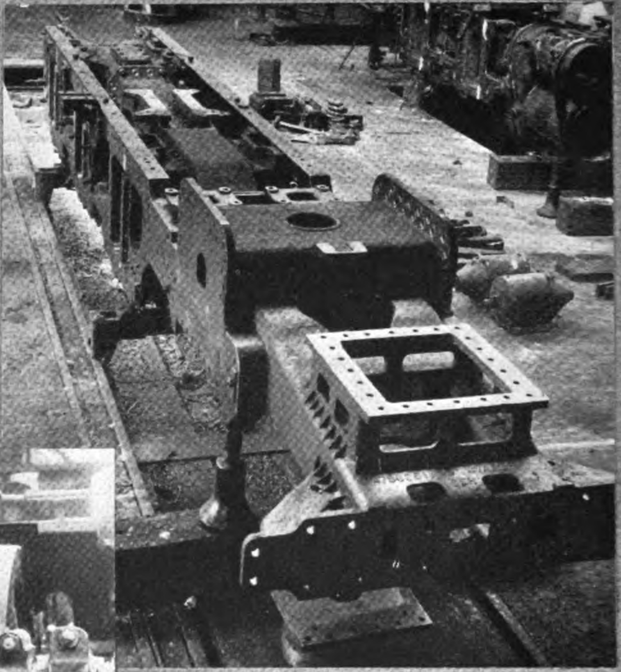
Left: The front deck and cylinder-saddle casting of the forward unit

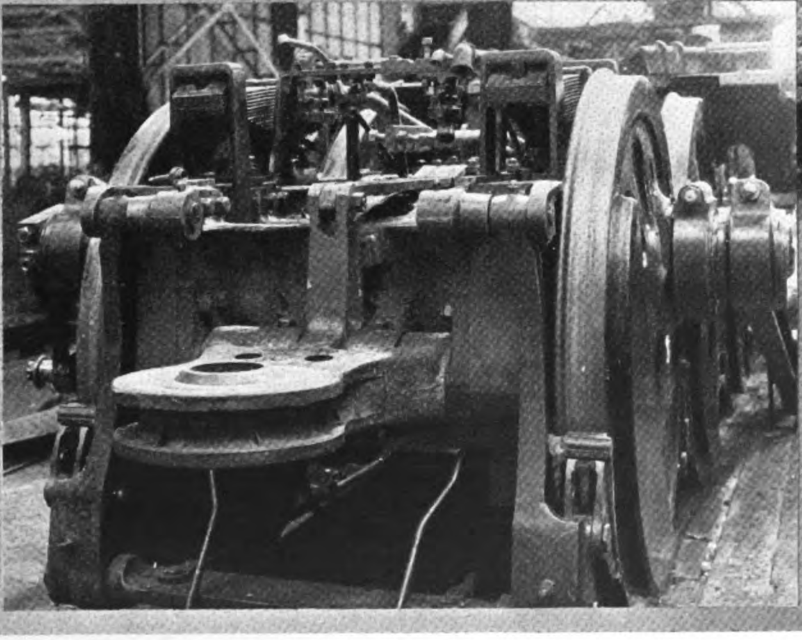
Right: The backbone casting of the forward unit





Above: The articulation casting at the rear end of the front frame system





Above: The front frame assembly with the deck backbone and articulation casting in place—Left: The articulation hinge at the rear end of the front unit showing the snubber connection

vertical movement of the bolster with respect to the truck frame, therefore, causes the discs to rotate in opposite directions, a movement which is restrained by the adjustable friction load on the discs imposed by a coil spring on the spindle.

The trailer truck is of the Commonwealth four-wheel type. The centering device on this truck is designed to produce an initial resistance of 8 per cent which builds up to a constant resistance of 15 per cent. Both engine and trailer trucks are fitted with SKF roller-bearing journal boxes, those on the front truck being of the inside type and those on the rear truck of the outside type.

The pistons are of solid rolled steel in Z-section fitted with the Locomotive Finished Material Company's combined bull ring and packing rings. The valve chambers are fitted with Hunt-Spiller bushings and the valves have Hunt-Spiller duplex packing rings. Paxton-Mitchell packing is used on both valve stems and piston rods.

The guides and crossheads are of the multiple-ledge type. The piston rods and the side and main rods are carbon steel, normalized and tempered. The same material is also used for the axles and crank pins.

The locomotives are fitted with Walschaert valve motion with the link blocks of each unit at the bottom of the links in forward motion. The reverse gear is a Franklin type E with 12 in. cylinder. It is directly connected to the reverse shaft of the rear unit and drives the reverse shaft of the forward unit through a reach rod extending forward along the center line of the locomotive with a crosshead and universal joint in the rear cylinder saddle.

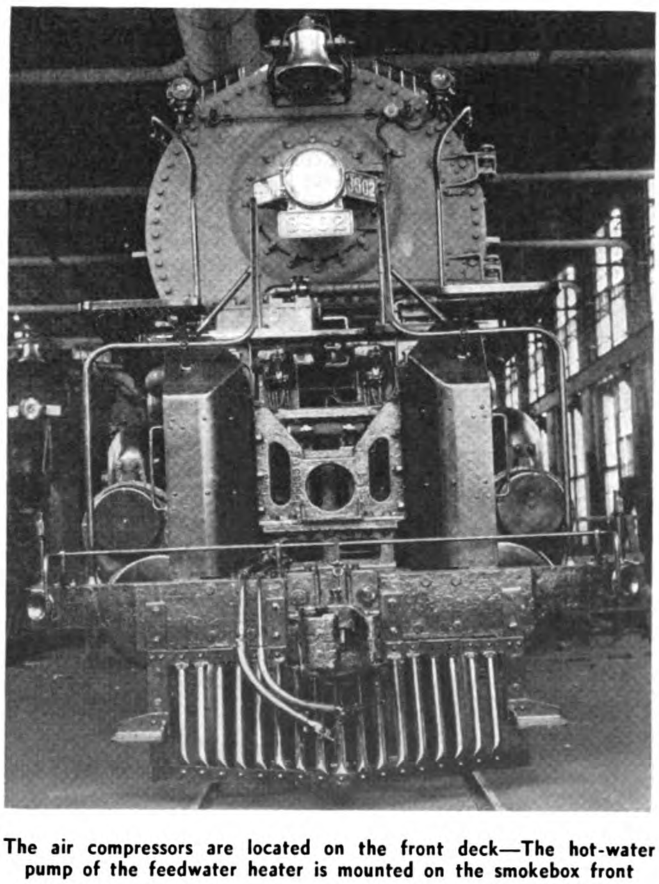
Alloy-steel bolts have been extensively used in the construction of these locomotives. Nickel steel is the material for all taper frame bolts, for boiler studs, cylinder-head studs, cylinder-to-frame bolts, and all steampipe bolts. The guide bolts, cylinder-saddle bolts, boiler-bearing bolts, the bolts in the front frame bracing

General Dimensions, Weights and Proportions of the Union Pacific, 4-6-6-4 Type Locomotive

Railroad	Union Pacific
Builder	American Locomotive Co.
Type of locomotive	4-6-6-4
Road number	3902
Date built	August, 1936
Dimensions	
Height to top of stack, ft. and in.	16—2
Height to center of boiler, ft. and in.	11—0
Width overall, in.	11—2
Cylinder centers, in.	89
Weights in working order, lb.:	
On drivers	386,000
On front truck	74,500
On trailing truck	105,500
Total engine	566,000
Tender	310,000
Wheel bases, ft. and in.:	
Driving	12—2 12—2
Rigid	12—2
Engine, total	59—11
Engine and tender, total	97—10½
Wheels, diameter outside tires, in.:	
Driving	69
Front truck	33
Trailing truck	Front, 36; Rear, 45
Engine:	
Cylinders, number, diameter and stroke, in.	4-22 x 32
Valve gear, type	Walschaert
Maximum travel, in.	7½
Steam lap, in.	1⅜
Exhaust lap, in.	⅛
Lead, in.	¼
Boiler:	
Type	Conical
Steam pressure, lb. per sq. in.	255
Diameter, first ring, inside, in.	96 11/16
Diameter, largest, outside, in.	102
Firebox, length, in.	213 1/16
Firebox, width, in.	108¼
Height mud ring to crown sheet, back, in.	80
Height mud ring to crown sheet, front, in.	84¾
Combustion chamber length, in.	90
Tubes, number and diameter, in.	222—2¼
Flues, number and diameter, in.	60—5½
Length over tube sheets, ft. and in.	22—0
Net gas area through tubes and flues, sq. ft.	10.55
Fuel	Soft coal
Stoker	Standard Type BK
Grate type	Firebar
Grate area, sq. ft.	108.2
Heating surfaces, sq. ft.:	
Firebox and comb. chamber	548
Arch tubes	77
Firebox, total	625
Tubes and flues	4,756
Evaporative, total	5,381
Superheating (type)	1,650
Combined evap. and superheat	7,031
Tender:	
Style or type	Semi-Vanderbilt
Water capacity, U. S. gal.	18,350
Fuel capacity, tons	22
Trucks	12-wheel
General data, estimated:	
Rated tractive force, engine, 85 per cent, lb.	97,400
Weight proportions	
Weight on drivers ÷ weight, engine, per cent	68.2
Weight on drivers ÷ tractive force	3.96
Weight of engine ÷ comb. heat. surface	80.6
Boiler proportions:	
Firebox heat. surface, per cent comb. heat. surface	8.9
Tube-flue heat. surface, per cent comb. heat. surface	67.6
Superheat. surface per cent comb. heat. surface	23.5
Firebox heat. surface ÷ grate area	5.78
Tube-flue heat. surface ÷ grate area	43.9
Superheat. surface ÷ grate area	15.3
Comb. heat. surface ÷ grate area	64.9
Gas area, tubes-flues ÷ grate area, per cent	10.3
Tractive force ÷ grate area	906.0
Tractive force ÷ comb. heat. surface	13.8
Tractive force × dia. drivers ÷ comb. heat. surface	955.8

A Comparison of Union Pacific 4-6-6-4 and 4-12-2 Type Freight Locomotives

Builder	American	American
Rated tractive force, lb.	97,400	96,650
Weight on drivers, lb.	386,000	355,000
Total engine weight, lb.	566,000	495,000
Cylinders, diameter and stroke, in.	4–22 x 32	2–27 x 32 1–27 x 31
Boiler pressure, lb.	255	220
Grate area, sq. ft.	108.2	108.25
Total evaporative heating surface, sq. ft.	5,381	5,853
Superheating surface, sq. ft.	1,650	2,560



The air compressors are located on the front deck—The hot-water pump of the feedwater heater is mounted on the smokebox front

Partial List of Specialties on the Union Pacific 4-6-6-4 Type Locomotive

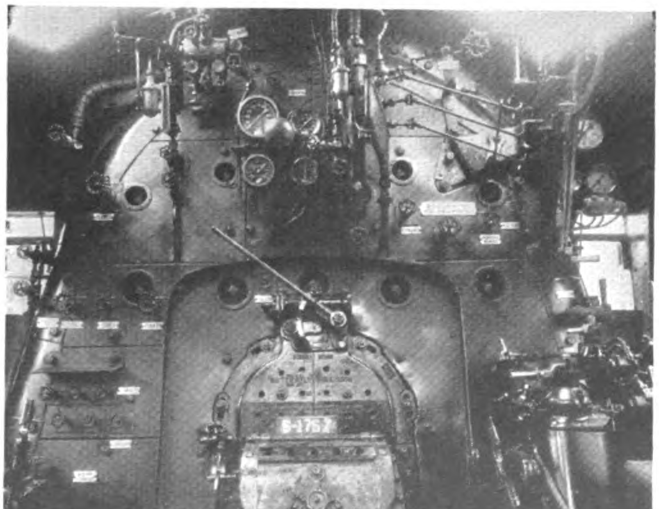
Frame cradle	General Steel Castings Corp., Eddystone, Pa.
Driving wheels, Boxpok	General Steel Castings Corp., Eddystone, Pa.
Engine and trailer truck wheels, rolled steel	Standard Steel Works Co., Burnham, Pa.
Tires, driving and back trailing	Latrobe Electric Steel Co., Latrobe, Pa.
Engine, trailer and tender-truck box bearings	SKF Industries, Philadelphia, Pa.
Brake equipment, 8-ET, with K-8PA engineer's brake pedestal	New York Air Brake Co., New York
Engine truck, cast-steel inside bearing type	American Locomotive Co., New York
Trailing truck, Delta	General Steel Castings Corp., Eddystone, Pa.
Radial buffer, type E-2	Franklin Railway Supply Co., Inc., New York
Reverse gear, Ragonnet type E 12-in. cylinder	Franklin Railway Supply Co., Inc., New York
Stoker, latest BK type	Standard Stoker Co., New York
Stoker gages, Duplex	Consolidated Ashcroft-Hancock Co., Inc., Bridgeport, Conn.
Grates, Firebar type	Waugh Equipment Co., New York
Fire brick	American Arch Co., Inc., New York
Fire door, Butterfly	Franklin Railway Supply Co., Inc., New York
Superheater, Type A	Superheater Company, New York
Smokebox hinge	Okadee Co., Chicago
Feedwater heater, type 6-SA (on 10 engines)	Worthington Pump & Machinery Corp., Harrison, N. J.
Exhaust steam injector, L. S., and type S non-lifting injector, R. S. (on five engines)	Wm. Sellers & Co., Inc., Philadelphia, Pa.
Injector, type HW Simplex, R. S. (on 10 engines)	Nathan Manufacturing Co., New York
Injector checks	Consolidated Ashcroft-Hancock Co., Bridgeport, Conn.
Cylinder bushings, Gun iron	Hunt-Spiller Mfg. Corporation, South Boston, Mass.
Cylinder cocks, steam operated	Prime Manufacturing Co., Milwaukee, Wis.
Piston valve bushings, Gun iron	Hunt-Spiller Mfg. Corporation, South Boston, Mass.
Lubricators, front engine, Model A (2)	Detroit Lubricator Co., Detroit, Mich.
Lubricators, back engine, DV-4 (2)	Nathan Manufacturing Co., New York
Lubrication—Valve gear, brake, hangers, throttle rigging, bell, smokestack hood, engine truck and front exhaust pipe joints	Alemite Corp., Chicago
Eccentric rod grease cups	Prime Manufacturing Co., Milwaukee, Wis.
Rod lubrication fittings	Prime Manufacturing Co., Milwaukee, Wis.
Flange oiler on front wheel of front engine	Detroit Lubricator Co., Detroit, Mich.
Flexible connections, between front and back engine	Barco Manufacturing Co., Chicago
Flexible connections between engine and tender	Franklin Railway Supply Co., New York
Steam heat	Vapor Car Heating Co., Inc., Chicago
Feed hose strainers: R. S. 10 engines	T-Z Railway Equipment Co., Chicago
L. S. 10 engines	Worthington Pump & Machinery Corp., Harrison, N. J.
R. and L. 5 engines	Wm. Sellers & Co., Inc., Philadelphia, Pa.
Lagging, standard magnesia	Johns-Manville Corporation, New York
Steam pipe covering, Insutape	Union Asbestos & Rubber Co., Chicago
Combined bull ring and packing rings	Locomotive Finished Material Co., Atchison, Kan.
Piston-rod and valve-stem packing	Paxton-Mitchell Co., Omaha, Neb.
Steam-pipe slip-joint packing	Paxton-Mitchell Co., Omaha, Neb.
Stoker and blower throttle valves	Consolidated Ashcroft-Hancock Co., Bridgeport, Conn.
All other valves	Lunkenheimer Co., Cincinnati, Ohio
Blow-off cocks and sludge remover	Wilson Engineering Corp., Chicago
Water gage	Wiltbonco Mfg. Co., Boston, Mass.
Water-gage glass, MacBeth reflex	MacBeth-Evans Glass Co., Charleroi, Pa.
Gage cocks	Prime Manufacturing Co., Milwaukee, Wis.
Safety valves and steam gages	Consolidated Ashcroft-Hancock Co., Bridgeport, Conn.
Sanders, ALE 101 type	Viloco Railway Equipment Co., Chicago
Throttle	American Throttle Co., Inc., New York
Whistle, chime	Consolidated Ashcroft-Hancock Co., Bridgeport, Conn.
Engineer's cab seat	Gustin-Bacon Mfg. Co., Kansas City, Mo.
Cab clear-vision window	Prime Manufacturing Co., Milwaukee, Wis.
Cab windshield wings	Prime Manufacturing Co., Milwaukee, Wis.
Handrail posts, two-piece type	American Locomotive Co., New York
Headlight, classification, cab lamps and headlight equipment	Pyle-National Company, Chicago
Train number indicator	Adams & Westlake Co., Elkhart, Ind.

system, pedestal-cap and engine-truck pedestal bolts, among others, are of chrome-nickel steel.

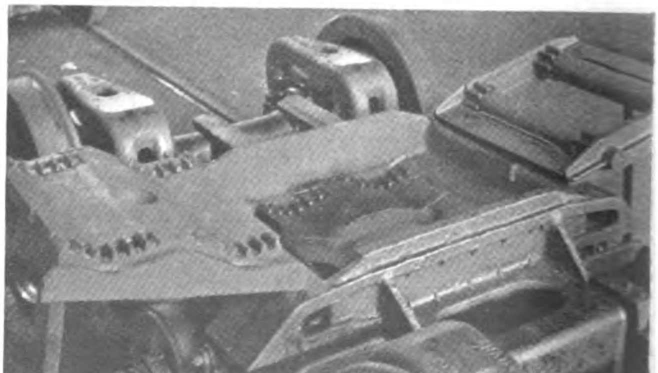
Steam Pipes and Lubrication

The steam pipes for both front and rear cylinders on each side are connected to a single secondary header outside the smokebox. To this header the front steam pipe is connected with a vertical ball joint. At the steam chest end it is fitted with a combined ball and slip joint. The relatively long steam pipe to the rear cylinders is fitted with a balanced slip joint at the steamchest connection. The cast-steel slip pipe is ported and packed on both sides of the ports with Unarco asbestos rings.

Each rear cylinder is provided with an independent



The back boiler head—The exhaust-steam injector control is shown at the extreme left



The geared lateral motion center plate of the engine truck—The friction type snubber is shown in the left foreground

exhaust pipe which extends forward along the boiler to one side of a Y-fitting at the nozzle base. The exhaust pipe from the front cylinders has the usual vertical ball connections both at the front (cylinder) and rear (exhaust nozzle) ends, with a ring-packed slip joint. The steam from both front and rear cylinders exhausts into a common exhaust nozzle chamber from which a single pipe connection leads to the feedwater heater mounted inside the front-end contour just back of the stack, or to the exhaust-steam injector mounted under the cab on the left side.

The front engines are fitted with Detroit force-feed lubricators with feeds leading to the cylinders, valves and guides and to the steam-pipe joints. Provision has also been made for oiling the flanges of the front wheels should this be found desirable. The rear engine unit is fitted with a Nathan force-feed lubricator with leads to the cylinders, valves and guides and to the steam-pipe joint.

The cabs on these locomotives are insulated with 2-in. paper-covered fibre glass, except for a wood lining on the roof. The fibre glass is also applied under the firing deck.

The interior of the cab presents an unusually neat appearance. All cab piping, as well as the valves, is concealed underneath the boiler jacket. The air brakes are New York No. 8ET with the brake valves pedestal mounted. Windshields at the cab side windows are Prime non-shatterable glass.

The Tenders

The tenders have cast-steel water-bottom underframes with tanks of semi-Vanderbilt form. They are carried on two Buckeye six-wheel trucks fitted with SKF roller bearings. The engine-tender connections are Unit safety drawbars with the Franklin Type E radial buffer. At the rear end the tenders are fitted with Miner A-78-XB draft gears.

Necessity for

Scientific Research

Many important questions relating to commonplace problems remain unanswered

COL. J. T. LOREE, vice-president and general manager of the Delaware & Hudson, gave an address at a recent meeting of the New England Railroad Club,* which proved to be unusually thought-provoking. This article covers those parts of special interest to mechanical-department readers.

In 1825, Nicholas Wood wrote, "The present state of commerce requires that goods should be conveyed from place to place with the utmost rapidity, and perhaps we owe no small portion of mercantile prosperity to our facility of dispatch," and in 1934 Alexander Gordon of London wrote, "Expeditious locomotion, to the commercial world more particularly in every mercantile transaction, is equivalent to capital and such is the vast importance of economy of time, here, that no extra expense is considered as too great to accomplish the utmost speeds. . . . Nay, we have lately seen the speed of eight miles increased to nine, though purchased at an addition of one-third of the original outlay and again accelerated to ten, though it could only be effected by doubling the whole costs."

Transportation Costs

But what affects the cost of the transportation furnished? First, the item of wages—usually not too high as a base, but if paid for non-productive or careless work or as arbitraries, excessive to that extent. Second, service of funded debt, in the form of interest payments and rentals. Third, the ever growing taxes both direct and indirect. Fourth, both state and federal commissions' requirements and regulations. And lastly, the cost of acquisition and maintenance of the physical units.

If you will consider for a moment, are you not rather startled to find how little basically we really know about any of these items, except most generally. May I enlarge somewhat on the last two. Much blame is cast upon the commissions as to the fixation of rates and the length of time it takes to get a change thereon. Would you, however, not find it hard yourselves to follow the logic of advancing rates, when the price of all other commodities was decreasing and then reducing rates when commodity prices were advancing.

Washing Boilers

Or again, the Bureau of Boiler Inspection of the Interstate Commerce Commission has ruled that boilers shall be washed out once a month. This is an item of considerable expense, directly as to the work and material involved, indirectly as to the loss of potential usefulness of the engine. The purpose, as you know, is to prevent the accumulation of scale in the boiler which decreases its efficiency and if allowed to exceed a certain amount results in a possibly dangerous condition. The real facts are that in locations where the water is heavily charged with alkalines, engines cannot possibly run 30 days without washing even with treated water, whereas in other locations where water is free from alkalis, scale will not accumulate in any appreciable quantity under some 90 days. In other words, fundamentally the chemical analysis of the water indicates the condition, but have the railroads ever presented to the Bureau a suggestion of a water analysis upon which a rational requirement might be issued?

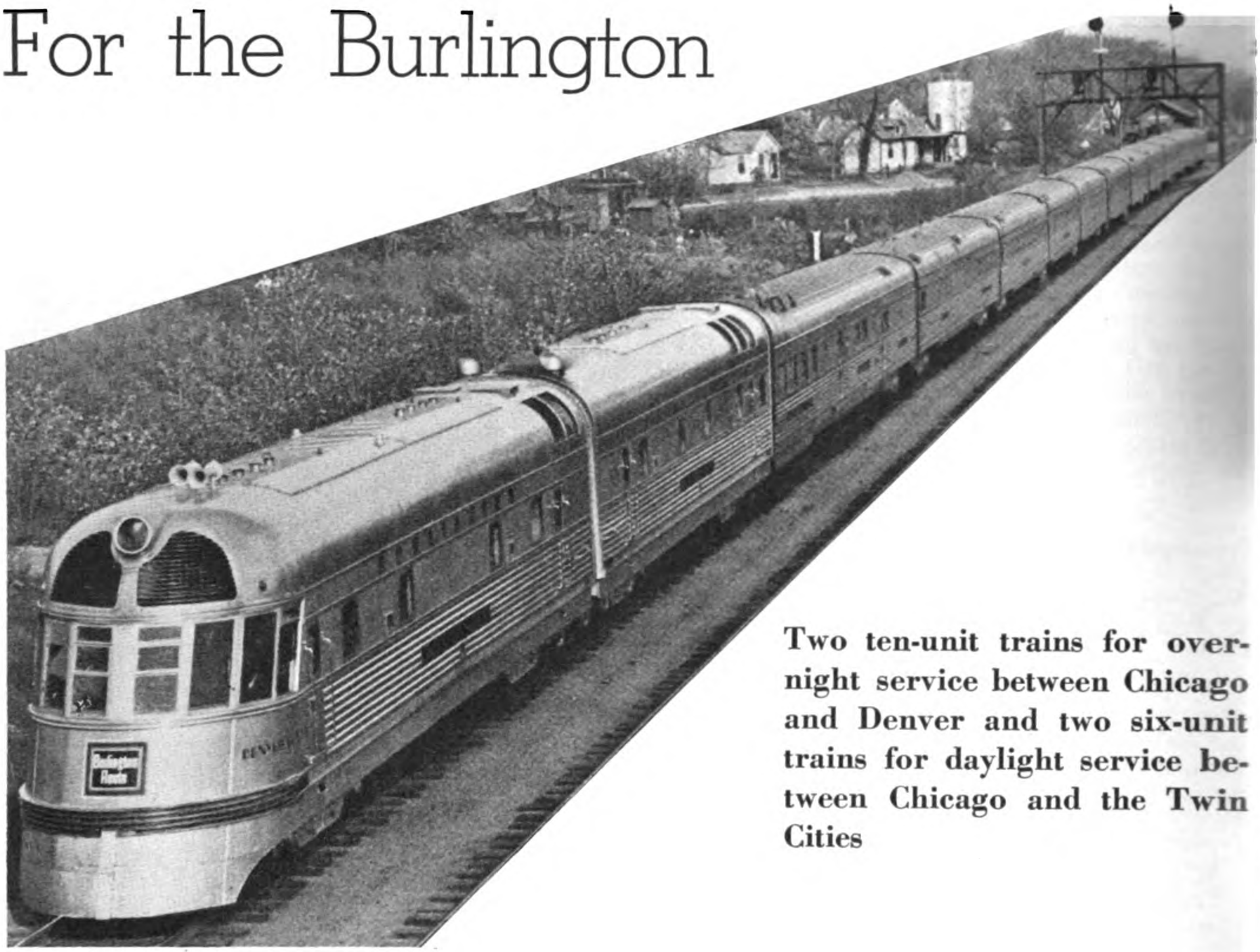
Consider our knowledge in the field of physical units. We draw cars by locomotives over rails. These locomotives are actuated by steam, electricity or oil and basically we know almost nothing about these agents. What is steam? Water subjected to heat above a certain point separates and gasifies. In this process it expands. We confine this expanding fluid in a cylinder which is fitted with a piston which is driven by the force of this expansion, and by a beautifiul mechanical device transfers horizontal motion into rotary motion. Now all of this was worked out by Watt and Bolton, Severy, Trevethick and Stephenson, over a hundred years ago. What we really

(*Continued on page 25*)

* October 13, 1936.

Four New Zephyrs

For the Burlington

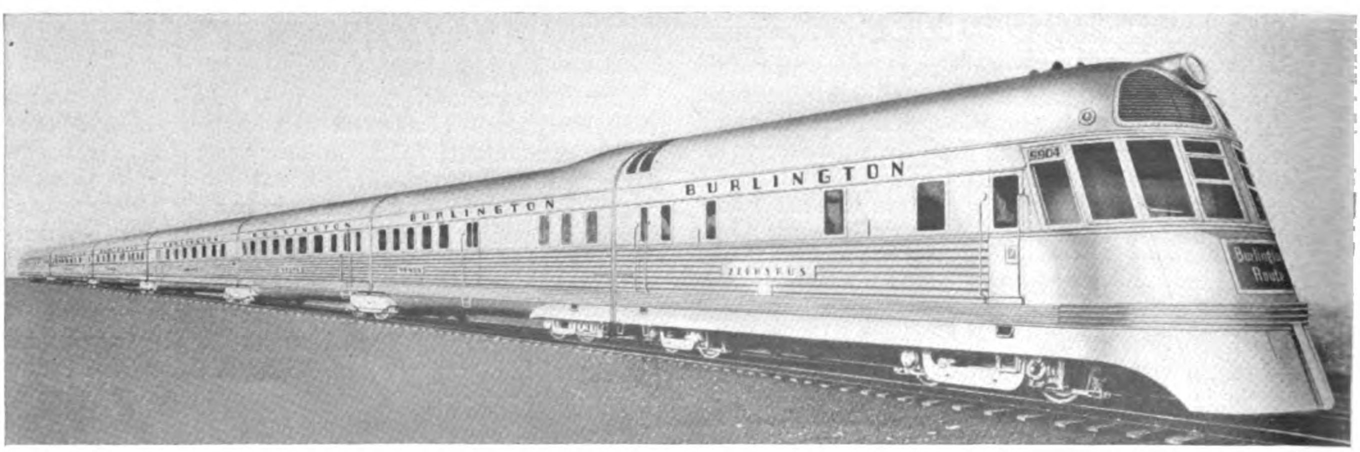


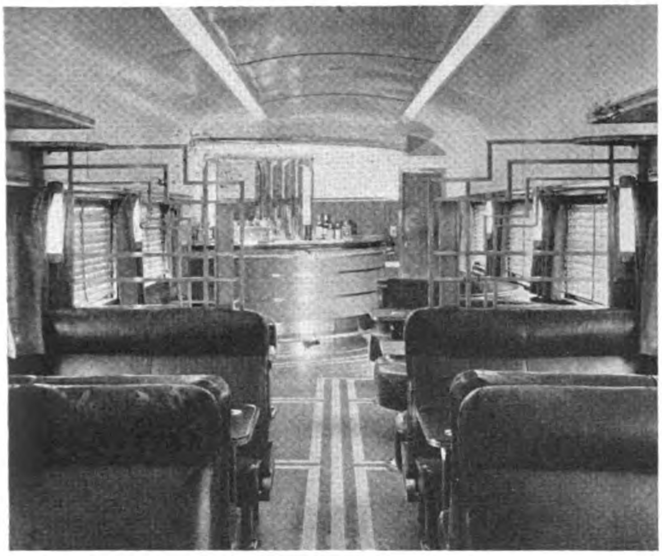
Two ten-unit trains for overnight service between Chicago and Denver and two six-unit trains for daylight service between Chicago and the Twin Cities

WITHIN the past two months the Chicago, Burlington & Quincy has placed in service four new light-weight stainless streamlined trains. These trains all of which were built by the Edward G. Budd Manufacturing Co., are hauled by Diesel-electric locomotives built by Electro-Motive Corporation. Two of the trains consist of ten partially articulated body units each. Included in them are four sleeping cars. These trains, known as the Denver Zephyrs, Nos. 9906 and 9907, were placed on regular 16-hour overnight schedules between Chicago and Denver, Colo., on November 7. Each of the other two trains consist of six fully articulated body units and is hauled by a single-unit 1,800 hp. Diesel-electric locomotive.

These trains, No. 9904 and 9905 and known as the Twin Cities Zephyrs, went into daylight service between Chicago and St. Paul, Minn., and Minneapolis on December 18.

Each Denver Zephyr consists of a combination engine-room, mail and baggage car; a combination baggage, crew quarters and cocktail lounge; two coach body units; a diner; three open-section body units; a drawing-room-bedroom-compartment unit, and a combination parlor and observation lounge unit. It provides seats for 100





One of the cocktail lounges with a four-section annex

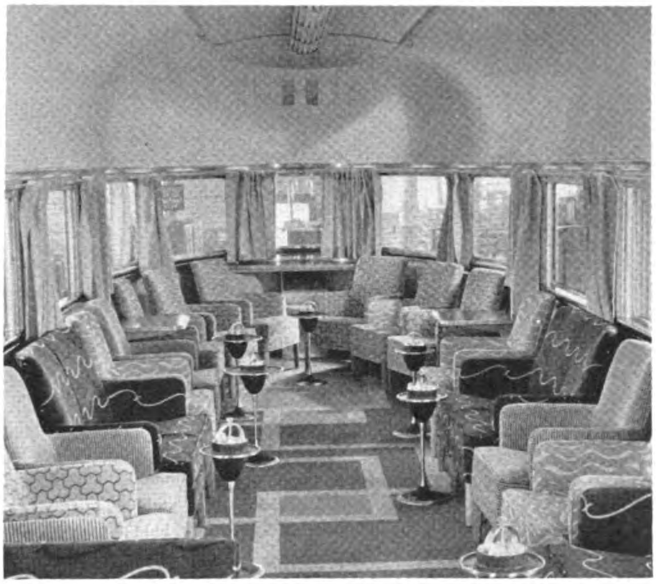
coach passengers, 93 upper and lower berths, 10 parlor seats, and 104 lounge and dining-room seats, with 31 additional seats in the men's and women's dressing rooms. Each of the Twin City Zephyrs is made up of a combination train-power, baggage and cocktail lounge; two coach bodies; a diner; a parlor car, and a parlor-lounge. It provides seats for 120 coach passengers; 50 passengers in the parlor cars, including 7 in the drawing room, 10 in the observation room and card section of the rear car; 30 in the cocktail lounge, and 32 in the dining room.

The Denver Zephyrs

The first revenue unit in each of the Denver Zephyrs consists of a two-truck car comprising an auxiliary power unit supplying 220-volt, 60-cycle, three-phase current for operation of lights, bar refrigeration and air-conditioning equipment. The equipment consists of four Diesel-driven generators each with its own control panel. Back of the engine room is a 30-foot railway post office and then a 24-foot baggage space. The second body unit is another two-truck car containing a 23-foot baggage space, sleeping quarters for the dining-car crew of 12 men with a shower room and lockers and at the rear end a cocktail lounge with a quarter-circle bar at the front.

The next three units are articulated to form a single vehicle. The first and second of these are coaches—the first providing rotating type seats for 64 persons with three-position reclining backs and removable center arm rests. The second provides similar seats for 38 persons. At the forward end of the first of these units are placed ladies and men's rooms and at the rear are two luggage lockers. In the second coach unit are two men's rooms—one a lavatory and the other a toilet. In the rear of the car is a spacious and luxuriously furnished ladies lounge and annex. The third unit in this articulated group is a 40-passenger diner with a 23-foot kitchen. The sixth and seventh body units constitute an articulated pair of section sleepers, each with a men's room at the forward end and ladies room at the rear. The eighth body unit is another 12-section sleeper and the ninth contains one drawing room, three compartments and six bedrooms. In each of the sixth and eighth body units are two "tall men" berths which measure 6 ft. 8 in. long. The others are $1\frac{1}{2}$ in. longer and slightly wider than those on conventional trains.

The tenth body unit is a two-truck combination parlor and lounge car with a buffet between the parlor and observation lounge sections.



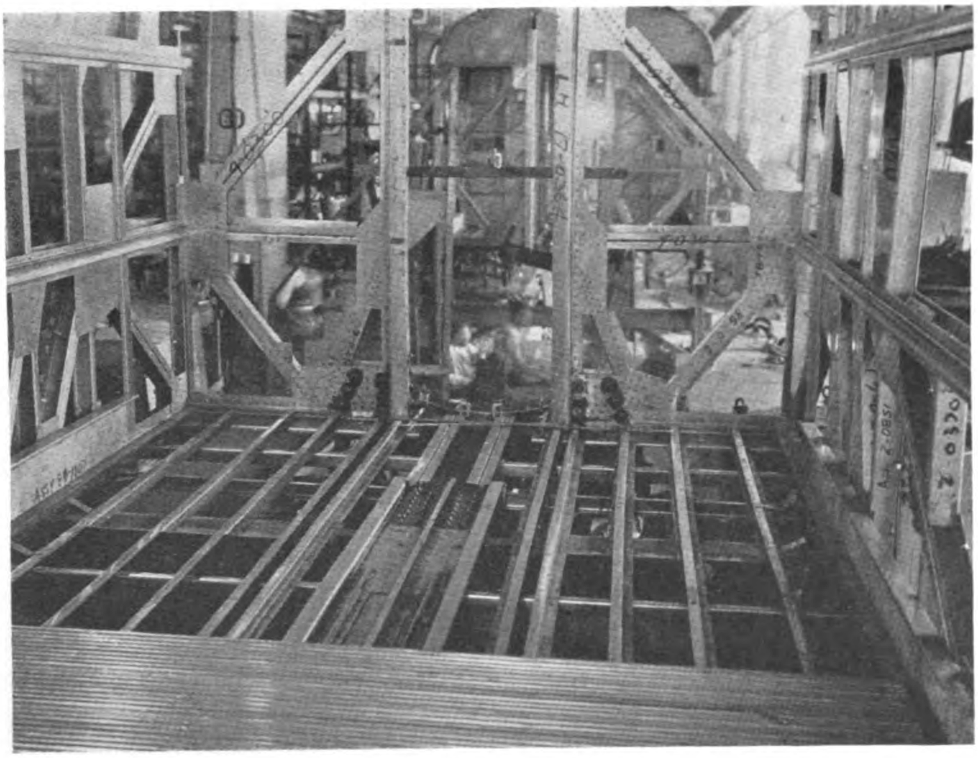
Observation-lounge of the Denver Zephyr

The Twin Cities Zephyrs

The two-unit Twin Cities Zephyrs differ principally from the Denver Zephyrs in the absence of facilities for

One of the coaches of the Twin Cities Zephyrs

One of the dining cars



The side and end frame and details of the floor construction

overnight travel. The first body unit contains an engine room with three Diesel generator sets for train lighting and other auxiliary power, a small baggage compartment and a cocktail lounge with bar similar to that in the Denver Zephyrs.

Each of the two coach units contains 30 Heywood-Wakefield transverse double seats. At the forward end of the first coach and at the rear end of the second coach are a men's lavatory on one side of a central passage and a women's on the other, in each case separated from the passenger compartment by a step well and side entrance doors. The fourth unit is a dining car similar in general arrangement to that on the Denver Zephyrs but with a dining room seating 32 passengers. On both trains the dining tables are arranged to seat four persons each, on both sides of the aisle.

The fifth unit is a parlor car with 19 rotating parlor chairs located in the portion of the car to the rear of the side-door step well. At the rear end of this car is a drawing room arranged with no upper berth but furnished with two transverse seats and a longitudinal sofa. Forward of the step well are men's and women's rooms on opposite sides of the car arranged and equipped the same as those in the coaches. The drawing room is provided with a lavatory. The rear unit on these trains accommodates 24 persons in rotating parlor-car seats and has six occasional chairs in the observation lounge at the rear end, with a card playing section between.

Body Construction

The car sheathing and structure, except the end underframe, needle beams and articulated end sills of all of these trains are stainless steel, known as 18-8. While this material is available in a wide range of physicals, those used in the construction of these cars are either high-tensile (150,000 lb. tensile strength), which is used for those parts where light-weight strength is most important, or low-tensile (100,000 lb. tensile strength), which is used where ductility or special finish is most important. The Shotweld process is generally employed in the fabrication of the stainless steel.

Fundamentally, the roof and under structure (floor stringers and belly side) serve as compression and tension chords of a beam. They are connected by a Pratt truss, modified as necessary for doors and windows. The longitudinal moldings serve to reinforce against localized stresses due to eccentricities. Necessary reinforcements are applied in accordance with determinations made in the analysis of the various components of the structure. In the vicinity of door openings which occur between truck centers the reinforcements are in the form of additional carlines and by flat sheets welded inside the corrugated roof sheets. Reinforcements of this type have proved most efficient in resisting shear at these points.

The end structure is properly analyzed to withstand buffing, traction, vertical and lateral loads that are to be expected in service and as specified by the Railway Mail Service. At the articulating joints the car body is riveted to an extended center plate made of annealed cast steel in which the side bearings are incorporated. The points of connection are amply reinforced to permit a satisfactory riveted joint, and the strength in effect tapered from this heavy casting to the light structure. The design of these end sills is such that the male casting on one car rests in a pocket in the female casting of the adjoining car and the female casting in turn rests in a pocket in the truck center plate. Vertical loads are withstood by the end truss of the car structure. The bending moment due to inherent articulation eccentricity is resisted by the sill casting, which extends into and is attached to a Cromansil needle beam and the stainless-steel center sill, and by a deep vertical beam extending to the roof on either side of the passageway. These vertical beams serve also as antitelescoping members meeting the Railway Mail Service specifications for full strength. The extended attachment of these beams to the roof is designed to withstand the shear developed at the upper ends of the beams.

At non-articulating ends, the under car structure consists of an end underframe made of Cromansil welded into a unit and subsequently stress relieved. The design of this unit is such that it serves as body bolster,

side bearings, draft-gear housing, end sill and center sill back to the stainless-steel center sill. This member is likewise riveted to the reinforced stainless-steel body structure.

The entire exterior is sheathed in stainless steel selected for finish. The combination of dull-finished paneling and bright-finished moldings presents a pleasing appearance which can be maintained by ordinary shop washing. The surface is unpainted except for lettering on letter board and name plates.

The doors throughout this train are so constructed as to fit flush and present a continuation of the body appearance when closed. The rails and the fluted panels and all other moldings which are interrupted at the door opening are applied on the door so that when the doors are closed there is no apparent break in the car contour. The baggage and mail doors are suspended from an overhead track and are guided by a floor track which leads the door from a flush closed position to an open position inside the car body. Passenger doors are double type, hinged on either side. In addition to the vertical split, certain of the doors are split horizontally approximately at the belt rail to permit the train crew to pick up train dispatches.

The interior doors are hinged in such a way that there is no possibility of pinching, although anti-pinch plates are not applied.

Outside passenger doors are fitted with folding steps which, when not in use, are folded into the car body and present an appearance similar to the body proper. A novel feature is a light mounted in the lower riser of these steps which is operated automatically by the trap mechanism. The steps themselves are faced with aluminum Diamondette treads with a nosing of punched and formed stainless steel as a guard against slipping.

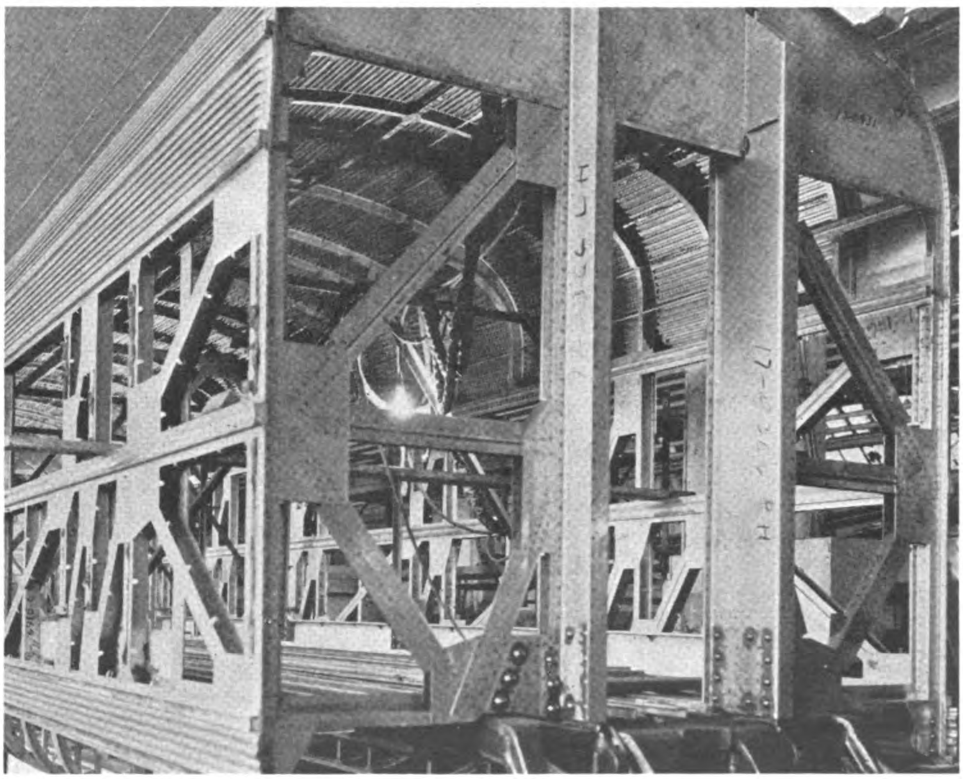
The side windows at passenger seats are of generous size. They are composed of two thicknesses of shatter-proof glass with a hermetically sealed, dehydrated air space between them. This dehydrated air space precludes the possibility of condensation on the inner glass when it is subjected to temperature drop. The hermetically sealed air space cannot change its water vapor content, nor can its dust content increase. The double glazing reduced the heat transfer. All sashes are inserted in stainless steel frames which are securely attached to the side frames with stainless steel screws. The glass itself is cushioned from the frames by the generous use of rubber.

The insulation of the passenger cars is Flame-Proofed Dry Zero applied as blankets to fit the voids between the inner and outer walls. The side-wall material is 3 in. thick and the roof and end material is 2 in. thick. The underside of the floor over the trucks is insulated by a corrugated or undulating layer of ½-in. Thermofelt, which is retained and protected on the underside by stainless-steel sheets attached to the floor stringers. Belly side insulation consists of ½-in. Hairinsul faced with Seisal Kraft paper, and the belly hatches are insulated with ½-in. Hairinsul protected with Mulehide. The insulation in the baggage rooms, Railway Post Office and engine-roof sides and roof is Navy type Alfol applied in six layers.

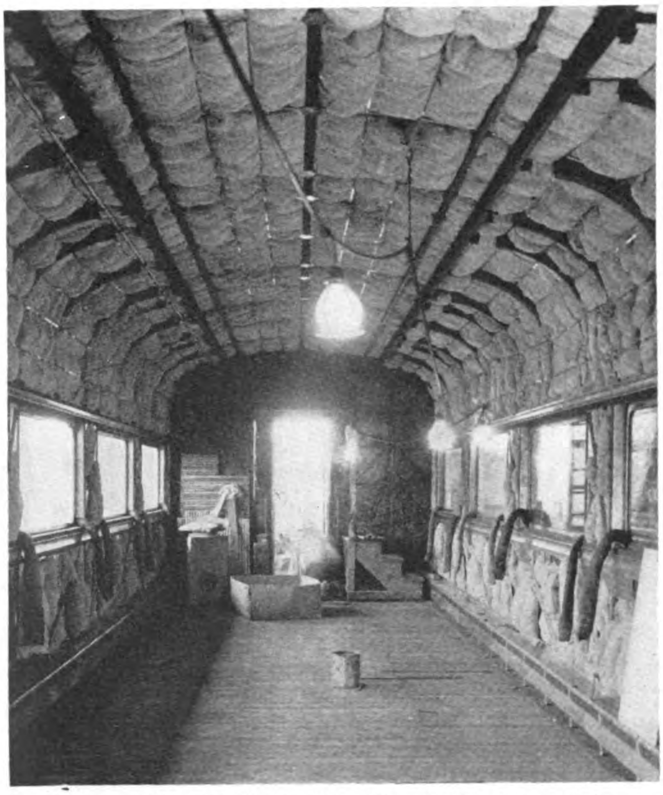
The cars in the Denver Zephyrs are fitted with automatic connectors made by the Ohio Brass Company. These connectors comprise air and steam, 220-volt power lines, telephone, control, and signal circuits. They are mounted beneath the O-B Tight-Lock couplers and the semi-permanent drawbars, which are applied in place of couplers between certain cars. Tight-Lock couplers are placed between the two locomotive units of the Denver Zephyrs, between the locomotives and the first cars of all of the trains and between the first and second cars and the fifth and sixth body units of the Denver Zephyrs. The semi-permanent bolted drawbars are used between the second and third units, the seventh and eighth units, and the ninth and tenth units of these two trains.

Train Power and Heating

Power for air conditioning, lighting, battery charging, ventilating, blowers, refrigeration, radios, telephones and various accessories, is generated by Diesel-engine gener-



Details of the end and side-frame construction of an articulated body unit



Application of the insulation in the roof and sides of one of the cars

ator sets located in the first car of each train. On the Denver Zephyrs there are four of these sets, on the Twin Cities Zephyrs, three. Each set consists of an 85-hp., 6-cyl. Cummins Diesel engine, driving a General-Electric 50-kw., 220-volt, 3-phase, 60-cycle generator.

The power from the generating units is distributed through the train by two three-wire train lines, one supplying the air-conditioning load and the other the lighting. Under normal conditions of operation the train lines are separated and supplied by separate generators, so that no flicker of the lights can be caused by the starting of air-compressor motors. In addition there is a two-wire battery train line. The electric controls of the trains and the starter motors on the engines are operated on 32-volt battery current. Under normal operating conditions the Exide batteries are kept up to charge by a 1½-kw. generator mounted on each engine, but there is also provided a 5-kw. generator directly connected to a 220-volt a.c. motor which can be operated on power from the train line.

Space is set aside in the engine room of each Twin Cities Zephyr for two Vapor automatic oil-fired boilers, because, no provision for train heat is made in the single unit locomotives for these trains. Each heating boiler has an evaporating capacity of 800 lb. per hour and operates at 200 lb. per sq. in. pressure. The fuel for the boilers and the Diesel engines is carried in a stainless-steel tank suspended between the floor structure and the under sheathing.

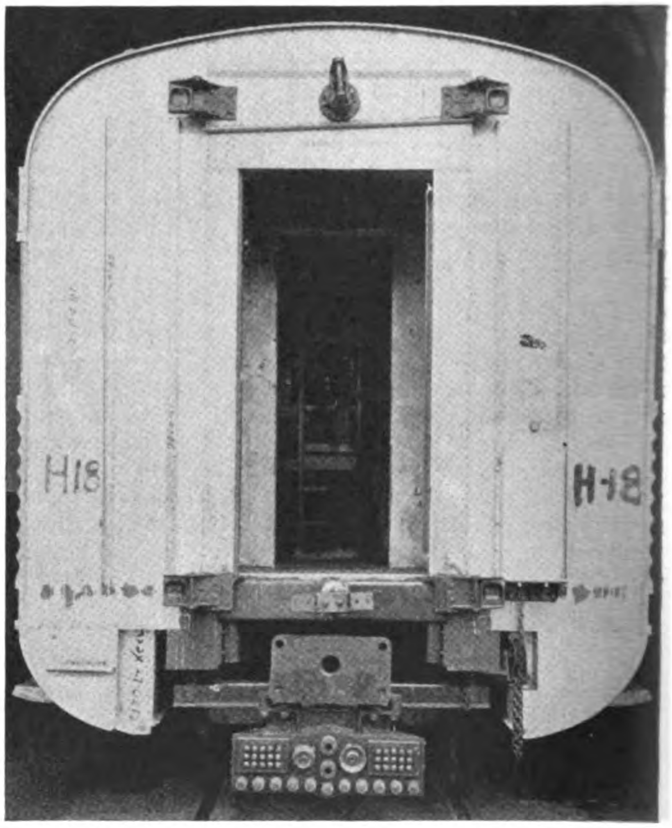
The Vapor heating system in these trains includes provision for returning approximately 75 per cent of the condensate from the radiators in each body unit to the supply tank. This system employs the standard type of Vapor regulator in the connection, above which is inserted a fitting by means of which most of the condensate is diverted to a sump underneath the car body. There is unobstructed communication, however, between the radiators and the Vapor regulator so that the usual temperature control of vapor admission to the radiators is effected by the 25 per cent of the condensate which is wasted. Each of the cars, except the second, is provided with a sump. Under the second car is located the main storage tank for the heating boilers and the condensate drains directly into the main tank.

Each of the sumps under the other cars is provided with a float-actuated solenoid valve which operates to admit air pressure to the sump when full. By this means the water is blown from the sump into the main storage tank.

This water reclamation has made possible a material saving in weight. Storage is provided for slightly less than 6,000 lb. of water, whereas over 20,000 lb. would have been required had all condensate from the radiators been wasted.

Air Conditioning

The air-conditioning equipment is as made by the Frigidaire Corporation and consists of electrically driven



One of the semi-permanent drawbar connections

compressors and condensors mounted beneath the floor of the cars with overhead thermostatically controlled, combination cooling and heating units and blowers. Each of the air-conditioning compressors is driven by a 220-volt, 3-phase a. c. line-start induction motor, with a full-load current of 38 amperes and a starting current of 166 amperes. A device called a program starter makes it impossible for two or more motors to start simultaneously. The air distribution is accomplished by openings in overhead ducts. The coaches, lounges, dining cars and parlor cars are fitted with overhead air ducts which deliver the conditioned air through an opening between the false ceiling and the underside of the lighting duct. The ducts are provided with vanes and other means for controlling delivery of air. In the section cars conditioned air is delivered by openings in the underside and on the side of the overhead ducts and, in addition, the air is conveyed to the lower berth by

vertical ducts which are built into the section headboards.

Filtered fresh air for the air-conditioning system is taken through openings in the sides of the car roof. Side-wall radiators, under thermostatic control, are located close to the floor. The thermostatic control of overhead and floor heat and cooling equipment is similar to that employed in existing installations on air-conditioned cars.

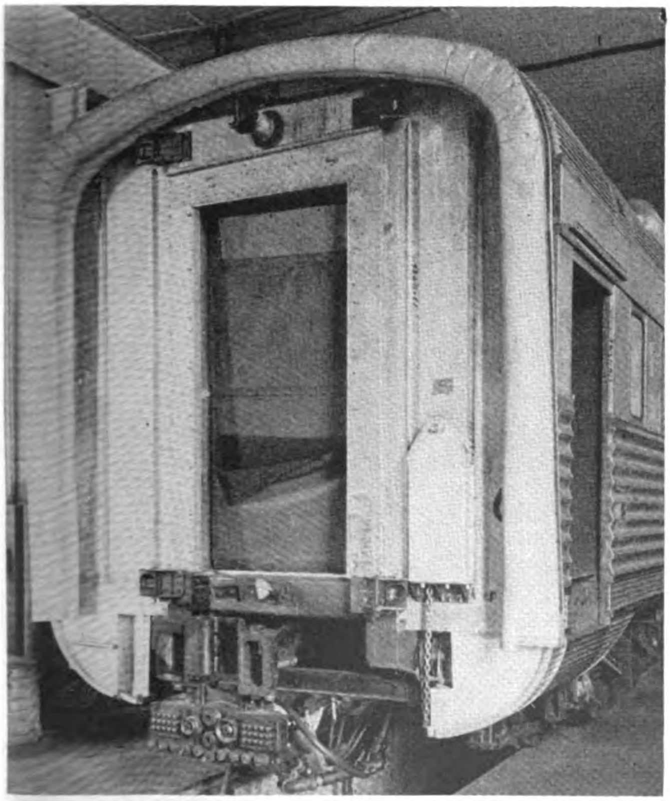
The kitchen ventilation comprises an air curtain to prevent kitchen odors from reaching the dining room, and three large Safety overhead exhaust fans. The air curtain is formed by outside air, taken through a grilled opening in the roof side, which is directed across the pantry-dining-room doorway in a layer from a duct constructed on either side of the doorway. The exhaust fans draw only a small amount of conditioned air from the dining room in excess of the air from the curtain.

Despite the lack of perceptible drafts the circulation of air in these cars is complete every two minutes. Enough fresh air is taken in during the operation of the air-conditioning equipment to provide a change of air in approximately seven minutes.

Lighting

Thirty-two-volt lighting is used throughout the trains. There is a 5-kv.a. single-phase transformer in each car, these transformers being connected over the three phases of the lighting train line, so as to balance the load in each phase. In addition to the 32-volt secondary for lighting, the transformers have a 110-volt tap which supplies outlets, in washrooms, drawing rooms, bedrooms and compartments, for electric razors, heating pads, curling irons, etc.

Emergency lighting is supplied from the battery. In case there is no 220-volt a. c. power available, a relay connects certain interior car lights, passageway lights, markers, etc., to the d. c. train line. When the a. c. circuits are again energized the relay is restored automatically to its former position and all lights are again operated from the a. c. power source.



An O-B Tight-Lock coupler and connector in place

All cars but sleepers and the observation-lounge sections of the rear cars have general indirect lighting provided by lighting troughs on either side of the central ceiling air-conditioning duct. The troughs are equipped with 25-watt lamps on 10-in. spacings, where the light is not augmented by baggage-rack fixtures.

Baggage-rack fixtures are used in the coaches and in the parlor sections. These are Safety Car Heating & Lighting Company fixtures, having double prismatic light distribution control and individual toggle switches. There is one 25-watt lamp in each unit and there is one unit over each coach seat or over each parlor chair. Where baggage-rack fixtures are used the ceiling ducts have 15-watt lamps on 15-in. centers.

Luminator lens-type lighting units, equipped with 25-watt lamps, are used in passageways, vestibules and in some washroom locations. There are also 25-watt step lights in louvered fixtures which throw light on the lower step. These lights are switched on automatically by the lowering of the step.

Two new types of Safety fixtures are used in the sleepers. The ceiling lights consist of an inverted white bowl, in which the light source is concealed by a longitudinal aluminum strip or band. Glass risers on either side of the band further diffuse the light. The unit is equipped with a 75-watt lamp.

The lower-berth lamps are also novel in form. They are spherical and are made of opal glass with a clear-glass circle or lens to furnish localized intensity for reading. One of them is fitted with a blue night light controlled by a toggle switch under the window sill. Each light has its own toggle switch for its 25-watt white light. The upper berths have two 15-watt fixtures of semi-spherical opal glass. The floor is lighted by aisle lights placed between alternate pairs of sections and staggered on opposite sides.

The observation section of each rear car has diffused lighting fixtures, making continuous cove lighting over the windows. These cove lights are fitted with double 25-watt receptables on 20-in. spacing. In the Denver Zephyr cars general lighting and lighting decoration is provided by a central ceiling light of molded flashed opal glass. It is semi-cylindrical in form and is made in ribbed sections which provide a continuous line of light. The light source consists of Lumiline lamps.

Brakes

The trains are equipped with electro-pneumatic modified HSC control air brakes operated by air pressure supplied from the locomotive. The cars are equipped with retardation controls which function on four selected speeds and operate in conjunction with the speed-control governors located on certain trucks in the train. The communicating signal is electro-pneumatic up to the first car in which is placed a solenoid valve to reduce the pressure and to operate with a charged signal pipe on the locomotive. Push buttons are located throughout the train in vestibules and other necessary points.

A control box is concealed in the table at the rear end of the observation room which contains train-signal push buttons, a back-up control valve, switch for the back-up lights, and a valve for the back-up horn. An easily operated trap door in the table gives access to the controls.

Trucks

All car trucks are four-wheel, double-equalizer, swing-bolster type with 33-in. wheels on an 8-ft. wheel base. The castings are of nickel steel, double annealed and drawn. The equalizers, spring-hanger safety straps,

cross-bar and swing hangers are steel forgings. The journals throughout are fitted with Timken roller bearings. Four hydraulic shock absorbers are applied on each truck to dampen the lateral swing action of the bolsters, and the application of special low cold flow rubber has been made at the points necessary to control the transmission of sound.

The Locomotives

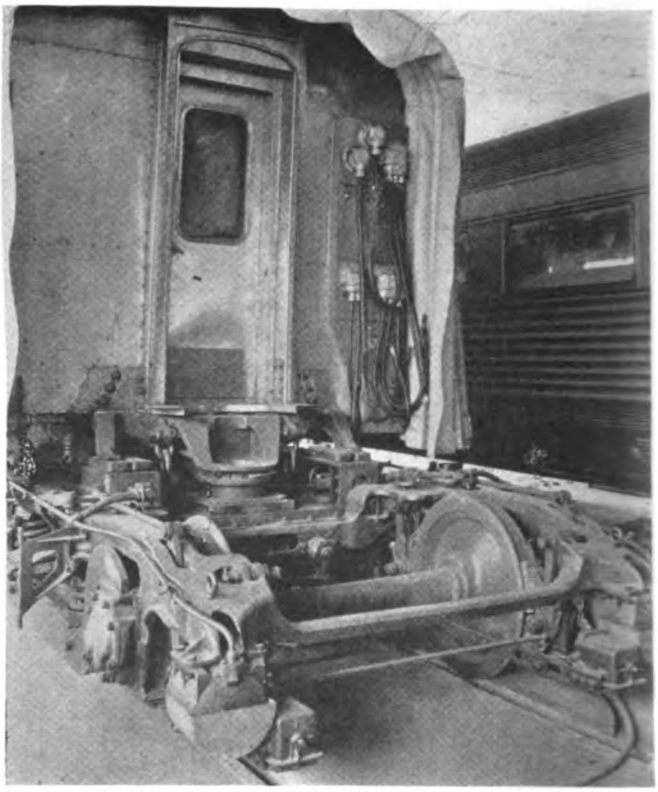
The locomotives for these four trains were built by the Electro-Motive Corporation at La Grange, Illinois. The leading units of the two 3,000-hp. locomotives for the Denver trains are practically the same in detail as the two 1,800-hp. locomotives for the Twin Cities trains. These units each weigh about 222,000 lb. and are 56 ft. 9 in. in length. Each houses two 900-hp. Diesel-electric power plants. These plants are EMC 12-cylinder, V-type, two-cycle engines, each directly connected through a flexible coupling to a General Electric d.c. generator. The power produced by each prime mover is delivered to the driving wheels from the generator through General Electric traction motors and control apparatus. The only interconnection between the transmissions from the two engines is in the control. Each truck has two nose suspended traction motors which are forced-draft ventilated by air supplied from centrifugal blowers driven by the main engines. The fuel tank holds 800 gal.

Auxiliary equipment consists of an auxiliary generator for main-generator excitation, charging the battery, operating locomotive lights, fuel pump and control equipment, a mechanically driven compressor and the air intake fans. A 32-volt MVAH 25-plate Exide Ironclad battery is furnished with each unit to supply power for starting, transmission control and all locomotive lights. These batteries have a capacity of 450 amperes at the ten-hour discharging rate.

The second unit of each of the 3,000-hp. locomotives, known as a booster unit, houses an EMC 16-cylinder, V-type, 1,200 hp., two-cycle Diesel engine directly connected through a flexible coupling to a General Electric d.c. generator. The auxiliary equipment for this engine is practically the same as that for each of the two power plants in the 1,800-hp. locomotive unit. In addition to those already mentioned each of the power plants includes a Gardner-Denver mechanical air compressor directly connected through flexible couplings from the shaft extension of the main power plant. These are two-stage, water-cooled machines with intercoolers and each is equipped with an unloader valve controlled by a governor. The rated displacement of each compressor is 79.4 cu. ft. per minute at 750 r.p.m. This unit is 55 ft. in length (over the body) and weighs 206,000 lb.

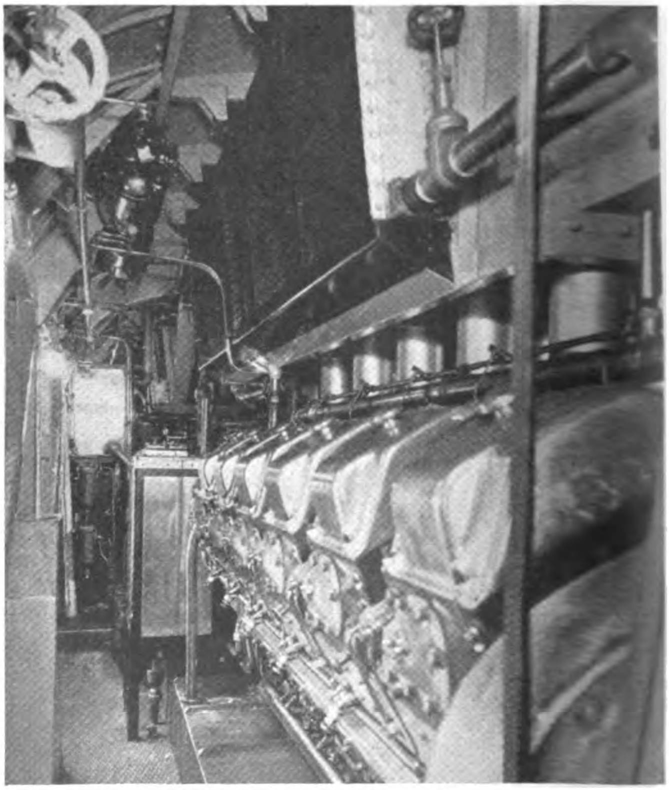
The booster unit also houses two vapor automatic oil-burning boilers, each rated at 1,500 lb. of water per hour at 200 lb. steam pressure. This unit carries a feed-water tank of approximately 1,000 gal. capacity and the burners of both boilers receive their fuel from the main fuel tank. This tank on the booster unit has a capacity of 980 gal.

The cooling system on both units is essentially of the same type as that on the earlier Zephyr trains. Each engine has its own separate system. The radiators are of the fin-tube type and are mounted in two sections, parallel to the engine and supported from a removable hatch directly over the engine. The water-supply tank is located below the level of the radiators to permit draining of the radiators when the engine is not running. A water circulating pump is located on the engine at the rear of the blower gear case. On each 1,800-hp. unit there are two 34-in. diameter air-circulating fans for each of the 900-hp. engines, these fans being driven



Rear end of an articulated body unit—The articulation casting on the front end of the adjoining unit is centered in the articulation casting of the unit already in place

off the camshaft through V-belts. On each 1,200-hp. booster unit there are four 26-in. diameter air-circulating fans driven through belts from a shaft extension of the main generator. The fans supercharge the engine compartment to approximately ½ in. of water pressure, which pressure is permitted to vent through the radiators to the atmosphere.



One of the 900-hp. Diesel engines

An exhaust muffler for each Diesel engine is located in a well in the hatch directly above the engine. The muffler is connected to the engine by individual pipes to each cylinder and exhausts to the air through stub riser pipes.

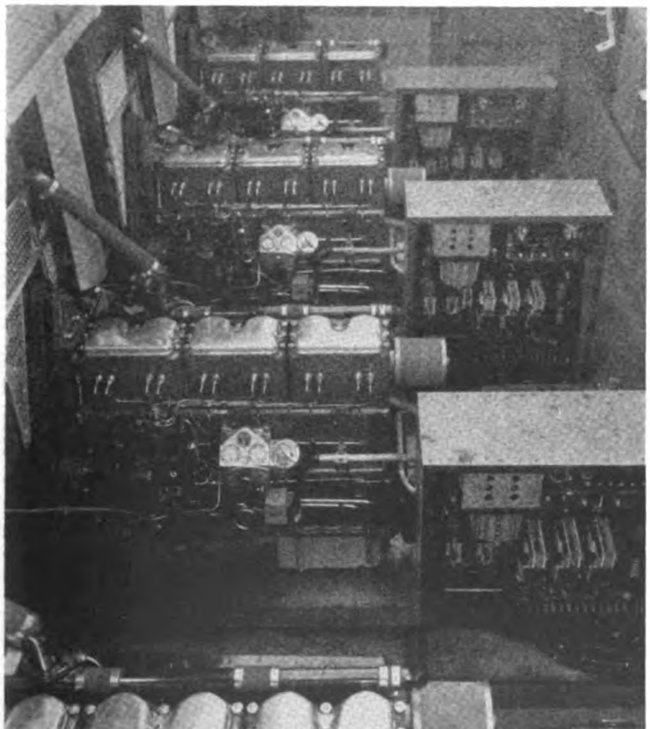
Each engine has its own complete lubricating-oil system which consists of an oil tank, oil cooler, oil filter and pump. The oil supply reservoir is a copper tank having a capacity of 60 gal. with a large opening at the top for easy filling. The oil cooler (two of these units are used with the 1,200-hp. engine) is a compact, water-cooled unit which has ample capacity to maintain the oil at the proper temperature. Large size oil filters are installed ahead of the cooler. The pump is driven by the main engine.

Lengths and Truck Weights of the Body Units of the Denver Zephyrs

	Length over couplers, ft.—in.	Weight: Truck numbers	Weight: Lb.
Auxiliary power-mail-baggage car	84—6	1 and 2	122,200
Comb. baggage, crew quarters, cocktail lounge	84—6	3 and 4	88,250
Coach	76—3*		
Coach	64—0†	9, 10, 11 and 12	217,900
Diner	73—6*		
Open-section sleeper	76—3*	13, 14 and 15	163,840
Open-section sleeper	76—3*		
Open-section sleeper	76—3*		
Drawing room, bedroom, compartment sleeper	76—3*	16, 17 and 18	168,290
Parlor, observation-lounge	78—8	19 and 20	80,990
Total	766—5		841,470
Locomotive	117—4		428,000
Total with locomotive	883—9		1,269,470

* From coupler pulling face to articulation center.
† Between articulation centers.

The lubricating-oil system includes the use of two dry sumps, one at each end of the crank pan, fitted with removable strainers. A dual scavenging pump draws the hot oil from these sumps and passes it through the filter and oil cooler to the oil supply reservoir. Cool, filtered oil is taken from the supply tank by the pressure pump and distributed throughout the engine at the required pressure as regulated by a pressure relief valve, which discharges into the crankcase. A device is provided to close the engine throttle in the event of a deficient oil supply.



The Diesel-generator sets in the first car carry the auxiliary and lighting loads

The locomotive body frame construction comprises a welded steel truss of the Howe type. There is no center sill. Buff and drag stresses are transmitted to the lower chords of the side trusses through beams which take the place of end sills. The members of each truss are connected top and bottom with large gussets and welded together in one unit. Where the frame members connect with the trusses, gussets develop the full value of the members. The floor and all equipment are supported on the bolsters and on cross members carried by the side trusses. At each end of the roof hatches, in addition to the end frame, extremely strong arches are provided of sufficient strength to take care of torsional stresses when jacking up the locomotive body at diagonally opposite corners. The stainless steel exterior and the front end are similar to those on the previous Zephyr trains. The front end sill of the 1,800-hp. units is 5 ft. deep and extends down to within 15 in. of the rail. The outside sheathing is supported on the trusses and carries no part of the body stresses. The structure is designed to meet the specifications of main-line railway mail service.

The Length of the Body Units and the Total Length of the Twin Cities Zephyr Trains

	Ft.	In.
First body unit, from face of front coupler knuckle to rear articulation center	76	3
Second body unit, between articulation centers	64	0
Third body unit, between articulation centers	64	0
Fourth body unit, between articulation centers	64	0
Fifth body unit, between articulation centers	64	0
Sixth body unit, from front articulation center to rear of body	75	5
Total	407	8
Locomotive	59	8
Total length, including locomotive	467	4

The material used in the locomotive body construction consists of high-tensile, carbon-molybdenum steel in all members where the section size is determined by stress. Members in which the sections are determined by the necessity for stiffness and not stress are made of mild carbon steel.

The cab or operator's compartment is separated in the forward end of the 1,800-hp. unit with the floor elevated to furnish an unobstructed view of both sides of the track. An insulated steel partition with doors separates the cab from the engine room and outside entrance door is provided on each side. All cab windows and doors have shatterproof glass and air-operated windshield wipers and window defrosters are installed on the front windows. All three power plants in the two-unit 3,000-hp. locomotives are operated from the one control station by means of the EMC multiple-control system.

Weight of the Twin Cities Zephyrs by Trucks

	Weight, lb.
Leading truck under engine-room-cocktail-lounge car	73,200
Second truck, between cocktail lounge and first coach	64,520
Third truck, between the coaches	58,430
Fourth truck, between the coach and kitchen end of diner	71,240
Fifth truck, between diner and parlor car	65,490
Sixth truck, between parlor cars	63,430
Seventh truck	40,030
Total	436,340
Locomotive	222,520
Total, including locomotive	658,860

All trucks are four-wheel power trucks of EMC design, equipped with Commonwealth alloy cast-steel frames, tested in the rough to 2½ times their normal

(*Continued on page 25*)

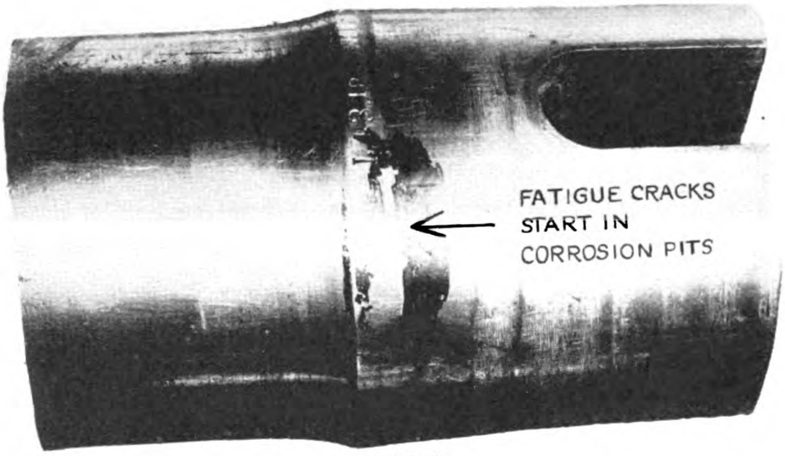


FIG. 1

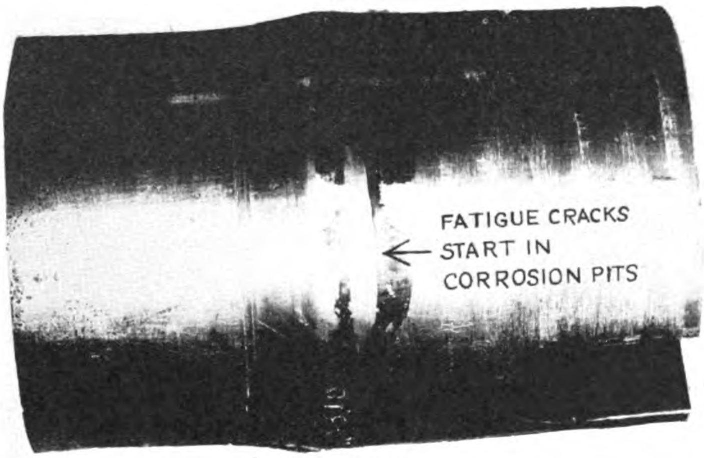


FIG. 2

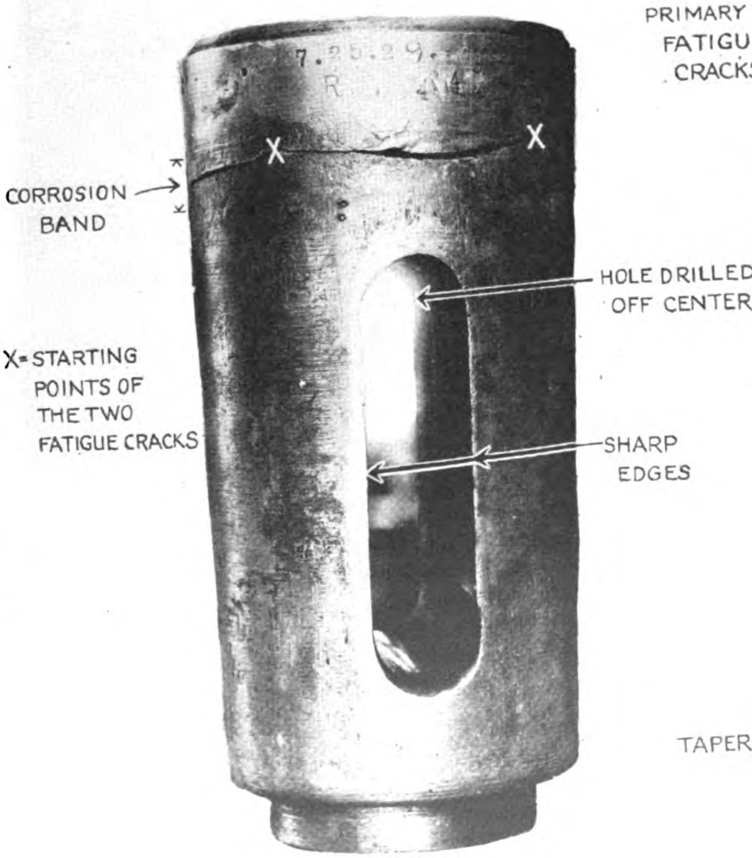


FIG. 3

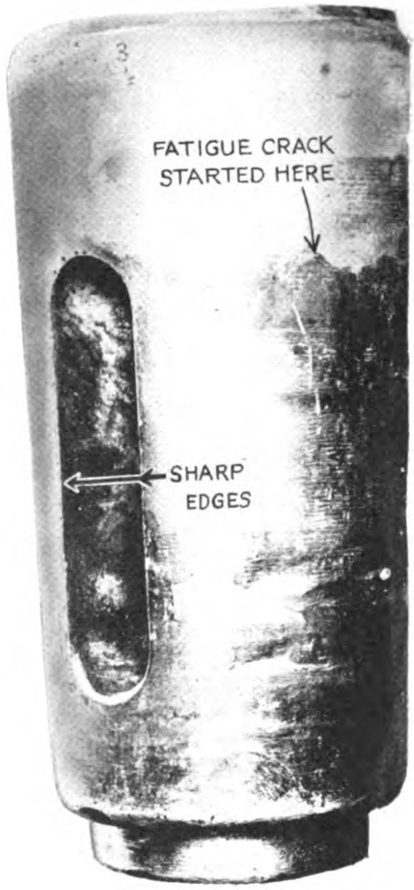


FIG. 4

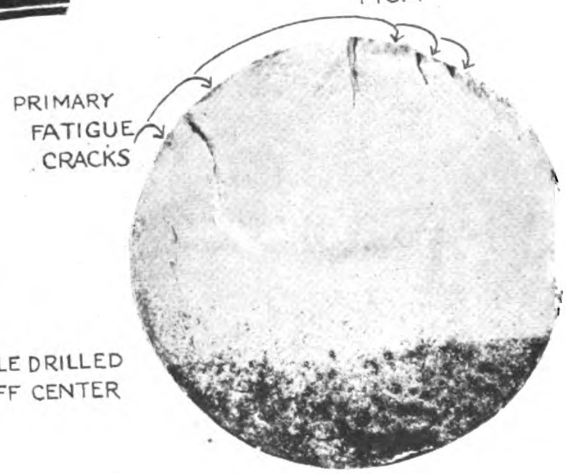


FIG. 5

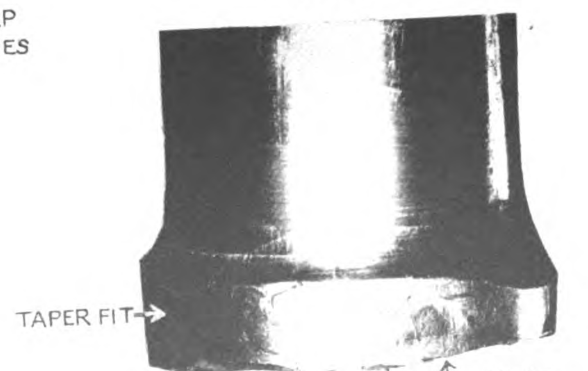


FIG. 6

Failures of

Locomotive Parts*

By F. H. Williams†

FEW failures of piston rods can be attributed to defects in the materials from which they are made—carbon and alloy steels—and the comments in this article will be confined to failures caused by poor workmanship and service conditions. It is easy to allocate a failure to one of three principal causes, and a brief study of the fractured ends will enable the decision to be made promptly. A further check is then required to make sure that the cause is that which was first assumed and that no other factors were involved.

We shall consider in this article only those failures occurring just inside the crosshead fit. This is a weak section and most of the failures starting therein are caused by stress-corrosion cracks. The corrosion is the result of pressure on the surface of the taper fit of the rod, because of the crosshead being keyed tightly on it. The surface is thus under pressure. On the other hand, there is alternate stretching and compression of the surface fibers when the piston is in operation. These reverse stresses, combined with the corrosion, start minute cracks, which in time develop into fatigue cracks and finally cause a complete failure of the rod. Even though the finish in the keyway itself may be defective, so that in time failure may result, it is significant that the breaks usually occur in this weak section.

Inspection of the Taper Fit

A considerable number of piston rods are scrapped long before they actually fail and much damage is thereby avoided; this is due to careful inspection of the rods, usually by the use of whitewash and a few blows with a hammer. When such rods are removed from the crosshead, they are cleaned and the taper fit is whitewashed and allowed to dry. It is then hit several blows with a sledge; if there are any cracks, the oil oozes out and leaves a stain on the coating of whitewash. Such cracks are from ¼ in., or less, to several inches in length. Obviously the rod must be scrapped. I have known of 13 piston rods being scrapped for this reason in one week in a main shop—a rather heavy casualty list, particularly on a large system which may have several such shops.

Figs. 1 and 2—Showing location of cracks in the taper fit of a piston rod. The fatigue cracks start in the corrosion pits. Fig. 3—Broken piston rod resulting from cracks in the rust or corrosion band. These apparently did not start in line with the keyway, but on either side of it. Fig. 4—Piston rod which had to be scrapped because of fatigue cracks starting in a corroded section. Fig. 5—Fractured end of a piston rod which failed in service. Fig. 6—Side view of a broken piston rod, the fractured surface of which is shown in Fig. 5.

Who is to blame for such failures? For some reason there seems to be a tendency to cover them up. This is unfortunate, for it is only by having them carefully reported and checked up that the actual conditions become known and steps can be taken to give the necessary amount of study and research to overcome the weakness. It should therefore be the shopman's first duty to report failures, so that the cause may be located and steps taken to reduce them to a minimum.

Stress-Corrosion Cracks

The photographs in Figs. 1 and 2 show defects in the taper fit of a piston rod. The fine cracks start in the corrosion pits, developing into fatigue cracks as the result of the reverse stresses combined with corrosion. It is interesting to note that these cracks are not in line with the keyway slot, but are to one side or the other of it. They are so fine that they do not show on the photograph, but the locations are indicated by the arrows.

The final results of such stress-corrosion cracks are shown in Fig. 3. They eventually develop into fatigue cracks and cause the failure of rods in service, unless they are disclosed by inspection while they are in process of developing. The photographs show clearly the band of corrosion pits, the cracks apparently starting at the points indicated by the two X marks. It will be noted, again, that these are not in line with the keyway slot, but are on either side of it. The edges of the keyway are also poorly finished and the holes at the ends of the keyway were drilled off center. These are hot beds for failures, but the more deadly enemy, the stress-corrosion cracks, beat all comers and caused the failure.

In the case of another broken piston rod, Fig. 4, the cracks occur farther down on the taper fit and about on a line level with the top of the keyway. Interestingly enough, the cracks did not start at the keyway, but well to the right of it. They were discovered by an inspection with the whitewash and hammer test. It may be well to note, also, the defects in the finish of the keyway. The punch marks at the top of the keyway are not good practice and should be severely condemned. The edges of the keyway are also too sharp and should have been rounded off with a good radius.

Figs. 5 and 6 show how another piston rod failed in the taper fit. In this case the fatigue crack extended almost across the section before the final failure. The rougher texture of the break indicates that section which parted last. Fatigue cracks started in several places, finally joining up and gradually extending until the rod was broken.

Still another instance of a stress-corrosion type of failure is shown in Figs. 7 and 8. The primary fatigue cracks are indicated by the black sections on the edge of the break. Here, again, the crack had progressed almost through the entire section before the final failure occurred.

Other Types of Failures

Another and more unusual type of failure is shown in Figs. 9 and 10. Here the surface of the taper fit was built up by the electric welding process. While stress-corrosion cracks probably also had some effect, it would appear to be poor practice to build up rods in this way, particularly since special attention is not given to preheating before the welding, and annealing thereafter.

In building up of worn surfaces by the electric weld-

* Part 7 of an article which began in the May, 1936, issue.
† Assistant test engineer, Canadian National Railways.

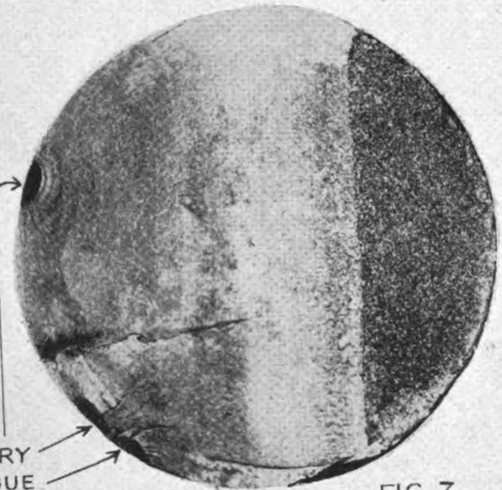


FIG. 7

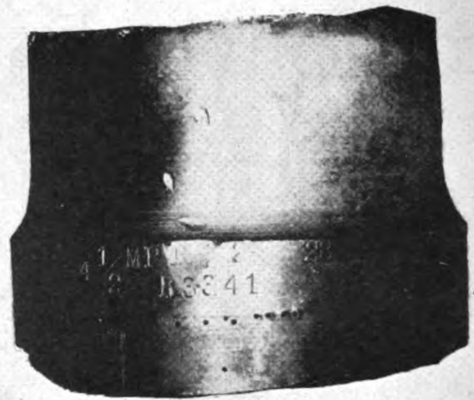


FIG. 8

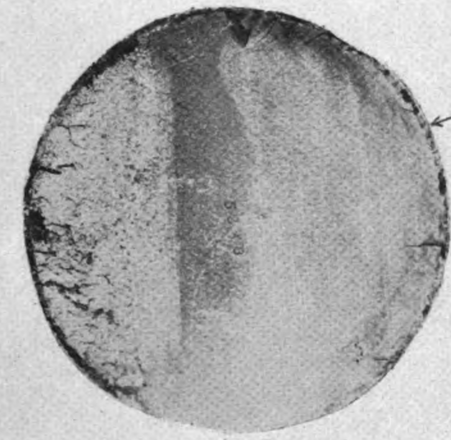


FIG. 9

FIG. 10

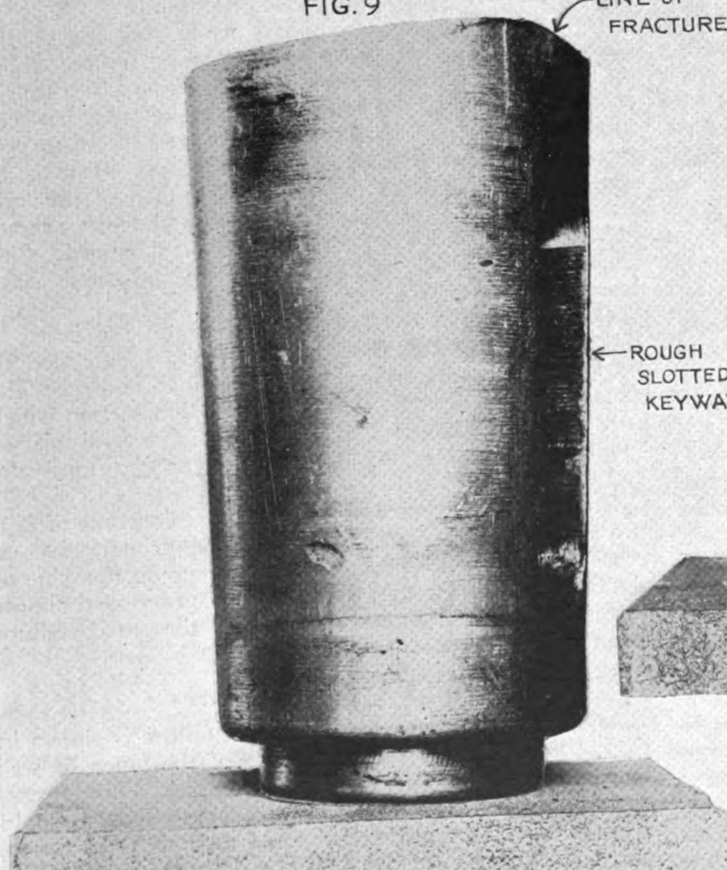


FIG. 11

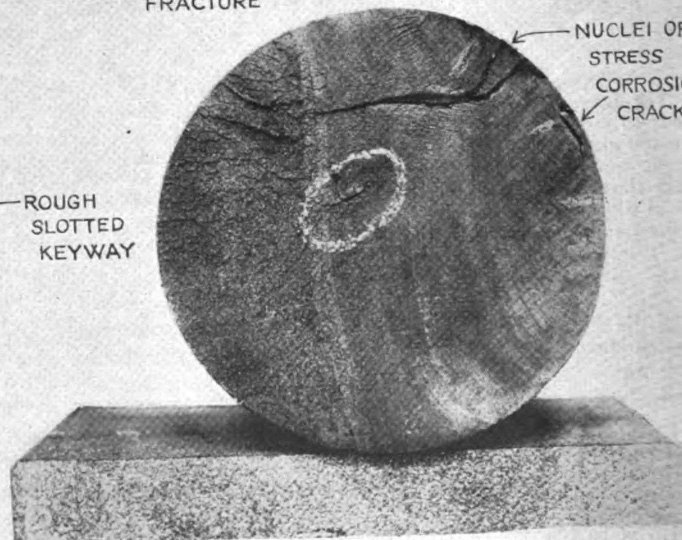


FIG. 12

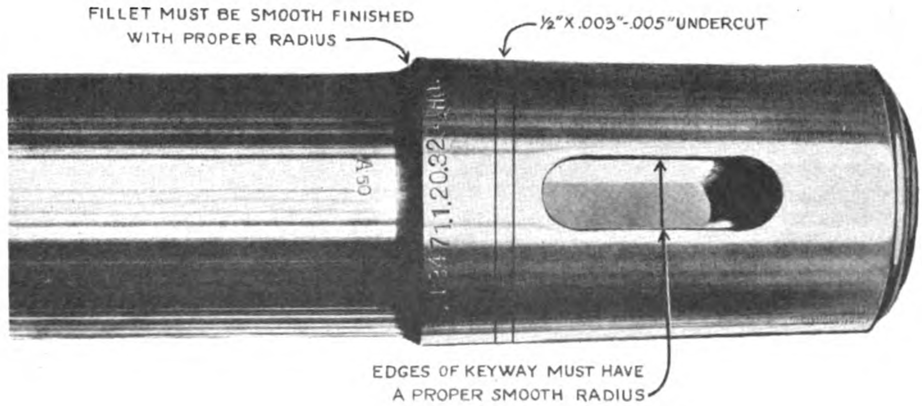


Fig. 13—Showing how piston rod should be finished

ing process the parts should be clean and free from grease. They should be preheated to from 1,100 deg. to 1,200 deg. Fahn. and kept there during the welding operation and then be allowed to cool slowly. The rod then *should not be annealed*. Tests have shown that such annealing is positively dangerous. Nitrides in the metal as deposited are generally harmless, but the annealing changes them into nitride plates which are dangerous, making the steel brittle and prone to crack. This applies generally to bare and some coated rods, but not to some of the modern properly coated rods. Annealing must not be regarded as a cure-all. Preheating is absolutely necessary in the higher carbon steel rods.

In the case of the break illustrated in Figs. 11 and 12, we find that it was primarily caused by stress-corrosion cracks. The fracture, however, indicates that there was also a flaw in the metal, although this seems to have played little part in the final failure, the cracks obviously starting from the surface.

The line of fracture, as shown in Fig. 11, appears in a rust or corrosion band, the frilled edges indicating that the cracks started in several different places and joined up as they progressed. The steel in this rod appears to be good and the crack had progressed more than half way across the section before the break occurred. It will be noted, also, that the taper fit is poorly finished; and that the holes in the ends of the keyway were drilled off center and the slotting of the keyway was unusually rough.

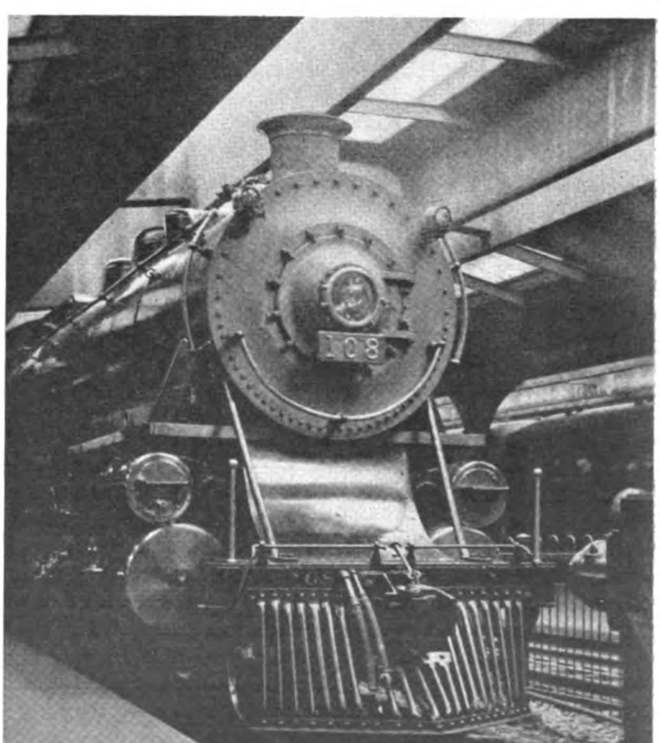
As the result of the study and investigation of such failures as have been described, piston rods are now being finished as shown in Fig. 13, except that the undercutting is not as yet used. Stress-corrosion cracks result from surface tension in the area of corrosion. Such surface tension, with infinitesimal stretching, results in frictional corrosion, which causes slight pitting in extreme cases, and the starting of stress-corrosion cracks. If you examine a piston rod removed from a crosshead after considerable service, it will be noted that the surface of the taper fit is coated with a fine red or black powder of iron oxide. If the case is a bad one, there will be a series of corrosion pits or even a band of corrosion slightly under the normal diameter of the rod. Even the best possible finish will not prevent such corrosion areas—the nesting places of stress-corrosion cracks.

Fig. 7—Fractured face of broken piston rod, showing clearly the primary fatigue cracks. Fig. 8—Showing location of break in taper fit of piston rod. (Face of fracture shown in Fig. 7). Figs. 9 and 10—Fatigue cracks of this broken piston rod started in metal added in building up by electric welding process. Figs. 11 and 12—Break caused primarily by stress-corrosion cracks, although there is also a flaw in the metal as indicated by the chalk mark.

In my opinion, such stress-corrosion cracks can only be prevented by undercutting or under-rolling, as indicated in Fig. 13. Ordinary finish will not give satisfactory service; ground finish will not do; the grinding and rolling of the surface will not suffice, so long as the whole surface is under pressure and reverse stresses. To get away from this we must undercut or under-roll a short band, about .003 to .005 in. deep and from ¼ in. to ½ in. thick. Undercutting removes the pressure from the surface in tension and tension from surfaces under compression. Such undercutting has been used for other parts with success, and it is urged that it be applied to piston rods as a real preventive for one of the most disastrous of causes of piston rod failures.

The grade of steel has little to do with the prevention of such failures. I have found that the best nickel steel will develop stress corrosion cracks as readily as carbon steel, although it is true that the better quality of material will lengthen the life of the rod before failure. In conclusion, we must not forget that the undercutting must have a perfect finish—polished surface, fillets and radii—else it will fail in accomplishing its purpose.

* * *



Operating experience with the

New Haven Comet

THE New Haven Comet, in April, 1936, completed its first year of operation as a high speed, de luxe train in shuttle service between Boston, Mass., and Providence, R. I. It is the first train of its type ever designed and built for this particular kind of service, and as a result includes many features—not only of interest but of hitherto untried operating experience. Now that the first year has been successfully negotiated and annual repairs completed, there has been an opportunity to appraise the various features of the train in the light of actual performance.

The Comet came east from Akron, Ohio, and was delivered to the railroad on April 27, 1935. Prior to this time it had undergone extensive adjustment and running tests, including some high-speed trials in which a speed of 100 m.p.h. was attained on straight, level track with the train still accelerating when the end of the test section was reached.

Between April 27 and June 5, 1935, the train was engaged in an extensive exhibition tour and a series of excursion runs. After making a total of about 4,500 miles in this manner, it entered regular service of five round trips each week day between Providence and Boston with an intermediate stop at Back Bay, a daily mileage of 440. On Sundays it was usually operated in special excursion service, the trip from Providence to Provincetown, Mass., on Cape Cod, and return proving especially popular.

With the timetable change on September 29, 1935, the schedule of the Comet was changed to include six round trips each week day between the two cities, and another station stop was included at Pawtucket-Central Falls. Daily mileage now became 528, and on alternate Sundays special excursion trips from Boston to New York and return were inaugurated. In connection with the institution of the additional stop it is interesting to note that it has caused no change in the mile-a-minute schedule between Boston and Providence, and has had little effect on maximum speeds in either direction.

Putting a train like the Comet into service presented several problems, the two most important being the instruction and training of operators, and the institution of a suitable and adequate maintenance program.

To start the train off, four enginemen, including the three who had "bid in" the Comet runs were sent to Akron, and handled most of the test runs there, the run east to New Haven, and the exhibition and excursion runs before the inauguration of regular service. At the start of this, therefore, there were available experienced operators. There was still, however, the problem of spare operators who would be available for extra runs or in case any of the regular men were off. Hence a number of enginemen from both Boston and Providence were qualified in the operation of the train. The procedure consisted of instruction on the train by an automotive inspector and an air brake supervisor, riding in the operating compartment, actual experience in handling the controls, and finally a written examination based on the book of operating instructions, supplemented by a

* Assistant engineer, New York, New Haven & Hartford.

By P. H. Hatch*

A record of the results of a year's operation, during which time the train ran 139,000 miles. Performance of Diesel engines an outstanding feature. Fuel consumption averaged one-half gallon per mile

demonstration on the train of proficiency in operation and handling. Re-qualification is required of men who have not operated the Comet within a stated period of time.

With the start of regular service on June 5, 1935, a daily schedule of maintenance and inspection was drawn up and put into effect at Providence where the train had its headquarters. A weekly schedule and a monthly schedule were also set up and made effective, and this work was done at Boston by the regular gasoline rail car organization at that point. With the timetable change and the daily six round trips instituted the latter part of September, the Comet was based in Boston, and the entire program of daily, weekly and monthly maintenance and inspection activities was undertaken by forces specially organized there. All the spare parts and supplies were concentrated at Boston also, so that this point became the Comet headquarters.

Maintenance Provision

The Comet has already been extensively described in different publications. The various features of the train, however, have such an important bearing on the kind and degree of maintenance attention that they will be briefly enumerated here.

In each end of the train are two entirely separate and distinct Diesel-engine generator sets. Each consists of a six-cylinder, 9-in. bore by 12-in. stroke, four-cycle, non-supercharged, Westinghouse Diesel engine rated 400 hp. at 900 r.p.m., and weighing about 23 pounds per horsepower without bedplate. Direct connected to each engine is a Westinghouse main generator with a continuous rating of 240 kw. and an auxiliary generator of the same make with a similar rating of 34.5 kw. On the motor truck under each end of the train are two Westinghouse 145 hp. (continuous rating) traction motors supplied with power from the adjacent engine generator set. The traction circuits in each end of the train are not connected together in any way; the speeds of the two Diesel engines, and series, parallel and reduced field connections of the two traction motors on each power truck, however, are simultaneously controlled from either end of the train. On the auxiliary circuit side the two power plants operate in parallel, whether supplying power from the main generators dur-

ing idling, or from the auxiliary generators at other times.

Auxiliaries on the Comet comprise control apparatus, battery and battery charging equipment, fuel transfer pumps, air compressors and motors, motor driven radiator fans, air conditioning and ventilating equipment, lighting apparatus, etc., and result in an exceptionally heavy auxiliary power demand. As an example, the lighting load alone requires up to 9 kw.

Other train auxiliaries include electro-pneumatically operated doors and folding steps interlocked with the air brake system to prevent injuries to passengers; oil-fired heating boiler with automatic control; specially developed air brake system with the decelakron feature for high speed operation—all of which have a direct bearing on train operation and maintenance.

Applying to the Comet the same principle of organized inspection and maintenance which has been so successful in the operation of electric locomotives and multiple unit equipment, lists of items to be attended to at daily, weekly, and monthly intervals were drawn up and put into effect. A so-called "work book" was installed on the train in which operators are required to list various information regarding operation, including defects noted for each trick worked, so that definite, thorough procedures were established for necessary attention. In the case of weekly and monthly work lists, mimeographed copies are sent in to headquarters showing that each item was inspected and left in OK condition; special work, or notations showing additional details regarding any of the items listed are shown on the reverse of the sheets.

To illustrate the system in general, the "Weekly Schedule of Inspection and Maintenance" of the Comet is reproduced below. The monthly schedule is quite similar except that it is considerably longer by reason of calling for additional items of work and more detailed inspection of parts.

It goes without saying that work lists of the kind mentioned are effective only to the extent that the forces doing the work are familiar with the type of equipment involved, are conscientious in the performance of their work, and are efficiently supervised. In this respect the railroad was fortunate in having available a group of maintenance men thoroughly familiar with gas-electric cars, so the transition to the Comet work was comparatively easy.

Operating Experience

Up to the time the train was taken out of service for annual repairs in April, 1936, the total mileage since the start of regular service on June 5, 1935, was 133,000 miles. This is exclusive of the approximately 6,000 miles run previously in testing, exhibition and excursions prior to June 5, or in other words, represents about ten and a half months of revenue operation.

Diesel-engine hours of operation for this period total roughly 4,500 hours, or at the rate of 5,200 hours per year; thus, though the total mileage may be low in comparison with other high-speed streamlined trains because of the characteristics of frequent shuttle service, the hours of service of the Diesel engines are comparable with engine hours for trains making greater mileage.

The necessity for quick turn-arounds at terminals dictated the double-end, two-power plant type of train; actual operation in service has shown this design to have incidental advantages of considerable importance. The use of a motor truck under each end of the train with the weight of a power plant thereon has resulted in smooth, even riding and tracking qualities with total ab-

Weekly Schedule of Inspection and Maintenance

A—Oil Engines

1. Drain fuel oil strainers (two in each engine room).
2. Make cylinder head inspection and check for fuel pipe leakage. Take up on holding down nuts.
3. Check end bearings and piston skirts.
4. Inspect throttle operating mechanisms and interlocks.
5. Clean air intake filters (alternate weeks).
6. Clean lubricating oil filter bags or install clean sets (alternate weeks).
7. Check all fuel pipes for chafing.
8. Check oil and water piping for leaks.
9. Drain water from fuel oil tanks.
10. Take care of oil engine items reported in work book.
11. Wipe down engines with rags.
12. Take sample of crankcase oil from each engine and forward promptly to laboratory at New Haven.

B—Electrical Equipment

1. Blow out and thoroughly clean main and auxiliary generators. Inspect brushes, brushholders, commutators, wiring around and under generators, etc. Check brush tension.
2. Blow out 600-volt cabinets and auxiliary apparatus cabinets and check all wiring, connections, shunts, fuses and blocks, etc.
3. Inspect and clean all contactors, unit switches, reversers, relays, interlocks, etc.
4. Inspect and clean master controllers and push button boxes.
5. Blow out and thoroughly clean main motors. Inspect brushes, brushholders, commutators, leads, etc. Check brush tension.
6. Inspect all main motor leads for chafing, clean off oil and dirt.
7. Blow out, clean and inspect radiator fan motors, air compressor motors, Freon compressor motors.
8. Inspect and clean fuel pump motors and couplings and check pipe connections for tightness.
9. Inspect and clean evaporator motors.
10. Inspect and clean exhaust fan motors.
11. Inspect and clean service water pump motor and boiler oil and water pump motors.
12. Inspect boiler control equipment and a.c.-d.c. motor-generator set.
13. Check for grounds on 115-volt circuits.
14. Inspect lamp regulators and voltage regulators.
15. Inspect all knife switches, snap switches, canopy switches, flipon switches, etc.
16. Inspect thermostat switches and service water pump pressure switch.
17. Clean both halves of storage battery, take gravity readings and flush, if necessary.
18. Inspect air compressor governor.
19. Inspect all terminal boards.
20. Take care of electrical items reported in work book.
21. Check sequence if any repairs or changes have been made which might affect switch or contactor operation.

C—Auxiliary Equipment

1. Inspect air brake equipment and piping.
2. Check air compressor oil levels.
3. Inspect all door engines, door and drum switches, interlocks, etc., and give necessary attention.
4. Check Freon compressor oil levels.
5. Clean evaporator unit air filters.
6. Check over all accessible Freon piping for leaks.
7. Inspect Vapor panels in each car.
8. Inspect magnetic steam valves.
9. Inspect all thermostat tubes and connections.
10. Repair any leaks and drips in steam piping.
11. Inspect boiler and auxiliaries and give necessary attention.
12. Check control line feed valves for proper setting (70 lb.).
13. Take care of work book items.

D—Mechanical and General

1. Take care of lubrication of all items shown as due in instruction letter and lubrication chart for The Comet.
2. Give trucks and running gear, brake rigging, etc., detailed inspection and make necessary repairs, replacements, etc.
3. Check hand brakes.
4. Inspect main motor gear cases and add lubricant if required.
5. Take care of work book items.
6. Clean up engine rooms and operating compartments.

sence of rear end whip or bouncing. Also in the case of failure of either power plant it has been possible to cut it out and operate the regular schedule with the loss of only a few minutes, and in some cases, practically on time.

The first six months of operation were notable for the absence of any delay of more than seven minutes due to mechanical or electrical equipment of the train. This particular delay, incidentally, was due to a stuck hand-brake at Providence station. Other failures of a minor nature had taken place, but repairs had been made in out-of-service times or had not caused operating delays of any consequence. For instance, it was necessary to rewind all the fuel transfer pump and evaporator fan motors for 140 volts instead of 115 volts, better to accommodate the auxiliary voltage of the power plants. Early in July an epidemic of failures of the air conditioning refrigerant flexible connections between cars at the points of articulation occurred, and was remedied by the redesign of the connections. About the same time, through failure to use the short-circuiting button provided to cut out a defective thermostat switch, all but three inches of cooling water was boiled out of the No. 1 engine system which gave rise to a number of unfounded rumors regarding lack of cooling, though both crankcase oil and cooling water radiator capacity is of more than ample proportions. In this case the No. 1 engine suffered no more serious damage than the necessity for renewal of cylinder head gaskets two or three weeks later. Additional supports for the brake rigging on the trucks were found desirable, and were installed during the summer. Certain bushings on the hydraulic shock absorbers on the trucks showed excessive wear; these were replaced with bushings made of a different material, and operation since then has been satisfactory in this respect.

The first failure of equipment causing the train to be withdrawn from service occurred on September 25, 1935, and was due to the failure of one of the traction motors. There had been a certain amount of conjecture regarding the general problem of running a substitute Comet. This was dispelled in a hurry, however, because of the suddenness with which the failure occurred, and the necessity of continuing service in spite of limited time at terminals. In this case a light Pacific type steam locomotive from a suburban train was pressed into service, and with two streamlined coaches, ran the Comet's schedule until later in the day Atlantic type locomotives were assigned. It is interesting to note that when the Comet is out of service, two coaches and three steam locomotives are required to operate the substitute service. This is, of course, because of the short turn-arounds and crew assignments.

In the first year of operation of the Comet, there have been several other instances of failures resulting in removal of the train from service. Such failures in all cases have been traced to defects in individual equipment parts and not to weaknesses in fundamental design of the train or its equipment. Furthermore the remedial measures taken have eliminated most of the troubles which have occurred.

As was to be expected with an entirely new type of train and service, various interesting problems arose which required special solutions. One was adequate ventilation of the operating cab at each end of the train. The only windows which can be opened are the two, one on each side, farthest around toward the side of the cab, away from the nose. It was suspected that the effect of the streamlining was such as to create a partial vacuum in the cab with those windows open and thereby draw in heated air from the adjacent engine compartment. The trouble was temporarily remedied by cutting ventilating holes in the horn housing at each end which could be closed by means of a slide.

Another special problem last winter was that of rain freezing on the outside of the front windows, also steaming up of the inside of these windows. Accordingly a six-inch non-oscillating direct-current fan was obtained and arrangements made for mounting and plugging it in at either end of the train. The scheme was sufficiently successful that a similar fan has been obtained in order to have each cab equipped. In summer these fans are used for ventilating purposes in conjunction with the holes in the horn housings; still further to assist in keeping the operating cabs cool in hot weather, metal deflectors have been installed.

Fuel oil consumption measured in miles run per gallon for the train as a whole, which includes heating in winter and air conditioning in summer, has averaged a little under two miles per gallon.

Overall Diesel engine fuel consumption for the Comet has averaged one-half gallon per mile run, or in other words, two miles per gallon. Engine lubricating oil consumption has averaged less than 3½ per cent of engine fuel oil consumption, or 60 miles per gallon. These figures are considered entirely satisfactory in view of the excessively high percentage of terminal time to running time which, again, is characteristic of shuttle service. Operating instructions for the Comet call for keeping the Diesel engines running continuously for all layovers of an hour or less, and the tendency has been to do this for some of the longer lay-overs also, since air conditioning in summer cannot be had without the power plants running and the storage battery alone is not adequate for supplying lights and main and boiler control demands for long periods without jeopardizing the required margin for Diesel starting.

At first there was some apprehension that so much idling would result in abnormally high dilution of engine crankcase oil, or other undesirable effects. Such has not been the case; dilution, which with other factors is checked by weekly analyses of oil samples, has been found to average about 2.5 per cent for both engines which is considered quite satisfactory. Lubricating oil, incidentally, has been changed at 25,000-mile intervals in both engines.

It is of interest to note that both power plants have operated together in balance throughout. No adjustment since the original final settings of the speed-load control equipment have been necessary as yet.

Annual Repairs

On April 22, 1936, the Comet was taken out of service for annual repairs and I.C.C. work. Due to the complete facilities available and the experience of the personnel involved, it was decided to handle such activities in the same place and by the same forces as had regularly been maintaining the train, instead of sending it to either of the two main back shops of the railroad.

Attention was centered in the program of inspection and repairs drawn up prior to the shopping, and throughout the work itself, on doing all that was necessary to keep the train in service during the ensuing year without resort to intermediate shopping for other than running repairs. Hence, as an example, all motor truck wheels were renewed, although the old wheels still had two or three months' wear left.

A detailed program of inspection and repairs was drawn up in a form similar to the weekly and monthly itemized lists which covered the four general headings of Diesel engines, electrical equipment, mechanical and general, and heating boiler. The work thus outlined was

done in addition to the regular monthly items due at the same time.

The Diesel engines were given what might be termed a light overhaul which consisted of inspection of cylinder heads and grinding of valves, pulling of pistons and renewal of all rings, inspection of the cylinder liners, connecting rod bearings and crankpins, check of fuel pump balance and timing, re-conditioning of Bosch nozzles, check of torsional vibration dampeners, check of governor condition and automatic timing advance, inspection of all gears that could conveniently be seen, and so on. In addition engine crankcases were thoroughly cleaned, lubricating and fuel oil tanks were cleaned, oil and water radiator gaskets renewed as required, and other works of a similar nature performed.

The electrical overhaul consisted of removal of main and auxiliary generators for inspection of the generator ball bearings, reinsulation and protection of leads, trueing up of commutators, etc. Traction motors were dispolished; the interior was entirely repainted and renovated, and drapes and seat back protectors dry-cleaned.

Prior to release of the train, a high-potential test was applied to every electrical part and circuit. Some of this, of course, was required by I.C.C. regulations; the balance was done to eliminate all possibility of grounds due to weak insulation or other defects anywhere. It is interesting to note that no trouble was experienced "shooting" the train, notwithstanding the number and complexity of circuits and apparatus involved. Incidentally, all circuits operate with metallic returns, grounded returns not being employed.

As would be expected, there was great interest to know how the various parts of a train as new as the Comet in equipment and arrangement and as distinct in type of service rendered would come through the first year of operation.

The Diesel engines were found to be in excellent condition; very little wear of parts being observed. Out-

Table I — Cylinder Liner Measurements

	No. 1 Engine					
	Liner at ridge		1 in. below ridge		4 in. from bottom	
Cyl. No.	Axial	Trans.	Axial	Trans.	Axial	Trans.
1	9.016	9.018	9.003	9.005	9.003	9.003
2	9.015	9.019	9.001	9.005	9.003	9.003
3	9.018	9.022	9.002	9.005	9.002	9.002
4	9.021	9.018	9.004	9.004	9.002	9.003
5	9.019	9.019	9.001	9.005	9.001	9.002
6	9.019	9.019	9.003	9.003	9.003	9.002
Average	9.018	9.019	9.002	9.0045	9.002	9.0025
Average	9.0185		9.003		9.002	

	No. 2 Engine					
	Liner at ridge		1 in. below ridge		4 in. from bottom	
Cyl. No.	Axial	Trans.	Axial	Trans.	Axial	Trans.
1	9.018	9.020	9.004	9.003	9.000	9.001
2	9.015	9.017	9.003	9.005	9.001	9.001
3	9.024	9.025	9.006	9.005	9.001	9.000
4	9.014	9.021	9.003	9.005	9.001	9.001
5	9.014	9.018	9.003	9.005	9.002	9.000
6	9.018	9.018	9.004	9.004	9.001	9.001
Average	9.017	9.020	9.004	9.0045	9.001	9.001
Average	9.0185		9.004		9.001	

Table II — Connecting Rod Bearings

	No. 1 Engine						No. 2 Engine					
Rod No.	1	2	3	4	5	6	1	2	3	4	5	6
Vert.	5.011	5.007	5.002	5.007	5.007	New	5.0065	5.0065	5.007	5.008	New	5.007
Horiz.	5.009	5.005	5.0075	5.005	5.004	Brg.	5.005	5.006	5.004	5.003	Brg.	5.0045

Table III — Crank Pin Measurements

	No. 1 Engine						No. 2 Engine					
Crank pin, No.	1	2	3	4	5	6	1	2	3	4	5	6
Vertical	4.9975	4.998	4.9975	4.9975	4.9985	4.9975	4.9985	4.998	4.9975	4.9985	4.9985	4.997
Horiz.	4.9975	4.998	4.998	4.998	4.997	4.997	4.999	4.9985	4.9975	4.9985	4.998	4.997
Initial dia.	4.999	4.999	4.999	4.999	4.999	4.999	4.999	4.9995	4.9995	4.999	4.9995	4.999
Diametral wear	.0015	.001	.0015	.0015	.0005	.0015	.0005	.0015	.002	.0005	.001	.002

mantled and cleaned, necessary attention given to commutators, brushholders, pinion and commutator end bearings, leads and so on.

Detailed and minute inspection was made of unit switches, contactors, reversers, relays and other parts of the control equipment and necessary annual attention given.

The air conditioning system throughout the three cars was inspected and the necessary work performed for the ensuing season's operation.

The six side doors were replaced on account of defects in the original doors, and the step treadles were renewed with treadles designed for a higher operating voltage. The door and step opening and closing equipment and control were given a detailed inspection and check.

The heating boiler was washed and given its annual attention preparatory to being taken out of service for the summer months.

Trucks, both motor and articulated, were removed from the train and completely dismantled, and necessary repairs made. As mentioned previously, new motor truck wheels were applied in both motor trucks.

The exterior of the train was cleaned, painted and side of renewal of all piston rings as a matter of policy, and replacement of gaskets, no new material was required except one turbulent ring (agitator) which had a hair crack in one corner, and two connecting rod bearing shells in which the babbitt had started to shell out. This material sufficed for both No. 1 and No. 2 engines; hence it can be seen that the item of new material required for the engine repairs was practically negligible.

Table I gives the recorded measurements of the cylinder liners made of centrifugally-cast nickel iron. The life of the liner is determined by the wear at the ridge formed at the top of the piston-ring travel. This wear, as is usual, is confined to a small distance as can be noted from the figures showing the diametral wear of .0185 in. and .0185 in. at the ridge to .003 in. and .004 in., one inch below the ridge. The manufacturer recommends a maximum of .075 in. diametral wear at the ridge before scrapping of the liner, and does not favor reboring for oversized pistons as an economical procedure. With the average diametral wear of .0185 in. over a total of 139,000 miles the average wear per 10,000 miles is .00133 in., giving a life expectancy of over 500,000 miles.

Measurement of the aluminum pistons showed an average of .004 in. increase in diametral clearances at

the extreme top of the piston in line with the thrust and .001 in. parallel to the shaft centerline. Piston skirt clearances did not change during this mileage. The width of the top ring grooves was within manufacturing tolerances, a gratifying condition, as this is generally the wear point on aluminum pistons which necessitates replacements. The wrist pin fit in pistons was the same as when new as the pistons had to be heated in water to effect removal of the pins. The crowns of the pistons were practically free of carbon with 1/32 in. to 1/16 in. coat on the underside of the crowns. All drain holes in pistons were clear with exception of drain holes to wrist pins which were found clogged. The piston rings were not measured for wear on account of the practice to renew rings as a matter of course at overhauls; however, no material increase in lubricating oil consumption was experienced during the 139,000 miles.

These engines have high chromium steel rings in the combustion space which give turbulence to the air with beneficial effect to combustion resulting in good exhaust conditions. One of these rings had to be replaced due to a small hair line crack having developed at a sharp corner.

The connecting rod bearings are bronze-back shells lined with Satco lead-base babbitt. Two bearings, No. 6 on No. 1 engine and No. 5 on No. 2 engine were renewed at this time due to small cracks in the babbitt. The condition of these bearings would not have affected performance for a considerable time. Table II gives the recorded readings of the bearings after disassembly and reassembly for measurement. The average vertical clearance was found to be .007 in. and horizontally .005 in. Normal fitting clearance is .003 in. vertically indicating diametral wear of .00029 in. per 10,000 miles. The top end of the connecting rod indicated that the clearance between wrist pin and bronze bushing had increased from .002 in. to .003 in.

Table III shows the measurements made on the crankpins of both engines. The average maximum diametral wear was found to be .0013 in. or less than one ten-thousandth of an inch per 10,000 miles. After check of thrust clearance and main bearing lift, it was decided to forego examination of main bearings on account of the more conservative loading of the main bearings compared to connecting rod bearings and the fact that the latter indicated satisfactory lubrication, although receiving their oil supply after the main bearings.

All valves and seats were found in good condition requiring relatively little grinding. The seats are made of steel and are cast in the aluminum head. The valve mechanism is lubricated by force feed at low pressure, giving satisfactory results as indications of wear were negligible.

Inspection of the auxiliaries disclosed satisfactory conditions with no need for replacements or overhaul. None of the gears in the driving trains at the free end of the crankshaft showed signs of distress. The fuel pumps were rebalanced for fuel quantities and adjusted for timing. Atomizers in the cylinder heads were returned to the manufacturer for reconditioning and adjustment.

It is apparent that the Diesel engines were found in remarkably good condition after the first year of operation. In fact it can be said that no feature on the train showed any better condition, if as good. The engines had an almost perfect record as far as responsibility for road delays was concerned.

The general condition of main and auxiliary generators, traction motors, control and auxiliary equipment was found to be good, requiring essentially nothing more than the routine work outlined.

A certain amount of truck work was necessary to correct somewhat excessive wear and breakage of small parts such as sand pipe brackets, pedestal linings, motor nose suspension wear plates, etc., but the main parts, including the shock absorbers, required little beyond routine attention. The superstructure of the train came through the year in fine shape and required no structural attention whatever.

Several cells of the storage battery were opened up at this time for inspection, and serious deterioration of the positive plates was disclosed. Further inspection showed that renewal of all positive plates was necessary immediately, and the battery was returned to the manufacturer for this work. The cause of the trouble was traced to the lack of adequate control of battery charging during idling periods which resulted in excessive overcharging. To correct this, the manually-operated three-position knife switch in each end of the train for controlling charging rates will be replaced at an early date with an automatic voltage regulator. This, incidentally, will also simplify operating procedures considerably in this regard.

Another condition unfavorable to long battery life has been the high temperature of the engine room in which the battery is located. The exhaust ejector system originally furnished for ventilation was not adequate for the amount of radiated heat from the engines and mufflers. Accordingly at the time of annual repairs steps were taken to shroud the manifold muffler of the engine involved and improve the scheme of ventilation by drawing air out from between the surface of the muffler and its shrouding and exhausting it outside. The shrouding of the muffler has reduced engine room temperatures somewhat, and experiments are continuing in working out the correct height of exhaust stack to obtain maximum ejective effect.

After the completion of the annual repairs two days were devoted to road test; the first day a 240-mile run was made with frequent stops initially to check bearings and running gear. When it was apparent that conditions were entirely normal the speed was stepped up until 50 m.p.h. on the return trip was reached. The following day two high-speed round trips were successfully made, and the Comet returned to regular service with the first scheduled trip the next day.

Operation during the summer of 1936 was entirely satisfactory, there being but four delays to service and these of a minor nature. It is felt that such a record for the start of the second year of service indicates both the effectiveness of the annual repair program and the success achieved in eliminating repeated failures of the same type.

Conclusion

Starting with the timetable change of September 27, 1936, the Comet is again based at Providence, and five round trips operated starting from Providence in the morning. Special Sunday excursions will be run as usual, starting either from Providence or Boston. It is expected that maintenance forces at Providence will handle daily and weekly inspection and maintenance, while Boston with more complete facilities for heavy repairs will handle these and all monthly work.

The Comet is daily performing one of the most exacting and difficult services known to modern transportation; exacting, in that short runs at high speed must be made on the main line of a busy railroad; difficult, in that turn-arounds are brief—there is little or no opportunity to make up time in case a few minutes are lost—and stops are frequent. That the train is conservatively designed and well built is proved by its performance; that it is doing its job as reliably and efficiently as possible for low mileage shuttle service is evidenced by its operating record.

Necessity for Scientific Research

(*Continued from page 7*)

know is that they found out that you could do it and have gone on doing it in the same way ever since. They worked under great handicaps, both in the lack of precision tools and in the lack of any great metallurgical knowledge. But in spite of the great advance in both of these fields, we, today do not know under what steam pressure and temperature it is most efficient to operate an engine.

The wheels of our locomotives are firmly fixed to the axles which turn in boxes which support and distribute, through springs, the engine weight. Though the attempt was made to turn the wheel on a fixed axle with the addition of the principle of the roller bearing over a hundred years ago—an attempt which failed due to the aforementioned condition of the metallurgical and tool makers' art—we still turn both axle and wheel, and when we use roller bearings we know that for some still unknown, though suspected reason, the axle breaks at the race way.

A century ago it was developed that if you trained the exhaust up the stack you created a partial vacuum which created a draft, whereby you encouraged a fire. Today we are still wasting power through back pressure in the cylinders to create the induced draft in the engine, and we are yet in ignorance as to a method of regulating the exhaust to properly work the fire under varying conditions.

More than 20 years ago I suggested to my trainmaster that it might be well worthwhile to study springs. Acting on the suggestion, he wrote a large publishing house in New York for a list of books on the subject. In due time a list was received—"The Cure at Baden-Baden"; "Mauheim and its Famous Baths"; "Saratoga Spa"; "History of Underground Waters." Was this list a reflection on the lack of interest in mechanical springs? Perhaps, for even today we know but little about springs as applied. Though the direction of motion is both vertical and lateral, we have confined ourselves almost exclusively to the former and in that direction only in part with the result, most engines and cars ride badly. What is the life of springs? Guarantees are quoted in terms of years which means nothing, but no one knows how many miles the springs will run.

After the production of some number of miles, an engine must be given classified repairs, but between these so-called general shoppings, how much maintenance, time and effort, is devoted to the 17,000 parts of a locomotive? Why cannot all the parts run free from repair between main shoppings in the absence of accident?

Car Problems

If we consider cars, we find somewhat similar conditions. We design channels and I-beams and needle beams of extra weight, that we may then extract part of the metal to afford opportunity to insert still other pieces of metal in the form of rivets. We place springs in trucks to resist the weight of gravitational thrust, but usually overlook the distinct discomfort of the recoil. The drawbar, as its name implies, was originally intended to link cars together, that they might be drawn in a group. Yet knowing this we still attempt to force a device, designed to pull, to absorb the shock of impact.

It was long ago discovered that if you had moving parts, some type of lubrication was necessary. To lubricate the journal we use the same method employed for the last 75 years and still the journals heat up and are either cut or the car is set out.

It may occur to you that I have given a picture that reflects but little credit upon my own profession; that I have pointed out too broadly in part, too detailed at other times, some of the questions in this transportation field. The questions asked or those implied are not propounded to belittle the achievements of the railroads. They have done and are doing a great work, and playing a large part in our industrial life. They are capable of the safest, fastest and cheapest transportation of persons and goods in the world. They have met every task set them; in the fair days of summer, in winter storms, in floods and other national disasters, in peace and war. They have established a reputation that no member of the profession need apologize for nor be ashamed of. But they have done it the hard way, hard for their patrons, perhaps, but harder for themselves.

They have restrictions and interference everywhere and adverse criticism; they have competition, regulation and taxation. All these make it difficult and are portions of the problems of the rails. But to me, above all these, they have these many unanswered questions, this great lack of basic fundamental knowledge, this thing which is attainable not through the effort to improve transportation specifically, nor the instrumentalities they use, but which requires that hardest and most honest of all work —pure scientific research. This is to me the real problem of the railroads.

Four New Zephyrs For the Burlington

(*Continued from page 15*)

load. Equalizers, made of special steel, stood a drop test of 2,000 lb. from 54 ft. without rupture. Wear plates, provided where necessary in the truck design, are made of high-manganese carbon steel. The Bethlehem 36-in. heat-treated multiple-wear steel wheels have 1 in 40 straight taper treads, ground after application to the axles, which have the same general dimensions as the E-12 axle, with 6½-in. by 12-in. journals mounted in Timken roller bearings. The trucks are equipped with Simplex clasp brakes, there being four brake cylinders per truck, with Westinghouse automatic slack adjusters connected on each side of the truck so that a hand-brake equalizing lever placed at one end of the truck will apply the brakes on all of the wheels. There are two 18-in. brake shoes per wheel. Houdaille double-acting shock absorbers are installed on all trucks between the bolster and the truck transoms.

Believe It or Not.—Snakes have recently given two railroad men the scare of their lives. Southern Pacific Signalman Bill Gleason's motor car ran over a small tumble weed on the track and a big rattlesnake was thrown up around his neck in some unexplained manner. Alfred Naylor, a shop worker, sat down at home one evening to enjoy his radio, but it refused to work when he turned the switch. Looking inside, he saw what appeared to be a stocking wrapped around one of the tubes. When he tried to remove it he was bitten by a 36-in. bull snake. Next time his radio gets out of commission he is going to call Frank "Bring-'Em-Back-Alive" Buck to fix it.

EDITORIALS

Importance of Research

Comparatively simple and commonplace details frequently interfere with the most efficient performance and shorten the service life of a tool or piece of equipment. The railroads started from exceedingly crude beginnings; the proper tools and facilities to build a highly efficient locomotive or car were not available in the early part of the 19th Century and it was only by a slow process that it was possible to improve and refine in detail the facilities and equipment used in railroad operations. Fortunately, in spite of this slow progress, the railroads were responsible for the rapid development of this country and the relatively advanced economic welfare of its citizens over widespread areas.

In the past few decades we have come into a new era—mass production with its cheapening of products and great forward step in economic progress. New factors have entered into the field of transportation and the railroads have been forced to furnish a much better type of service than was even dreamed of in the late 90's. Today, they are fighting for their lives in competition with other forms of transportation, and under this stress are reaching out in a variety of ways and doing many things not only to improve their services, but at the same time to lower the costs of such services.

In doing this, however, they are only keeping pace with other wide-awake industries. Not a few corporations, for instance, have come out of the prolonged depression with flying colors, because of research, not only as to materials, designs and production processes, but also in the field of promotion and merchandising. The argument may be advanced that our cars and locomotives and the facilities for maintaining and repairing them are ample, or at least, that they are giving reasonably good service. Why, therefore, fuss about them?

The great difficulty is that so many of us are inclined to take things as we find them. We fail to progress because we do not stop to analyze and study details and problems which have become so commonplace that we allow them to pass by unchallenged and even unnoticed. The few who do cultivate the faculty of seeing these things have an exceedingly difficult time awakening the rest of us to a recognition of the shortcomings and the necessity for adopting new designs or new methods and practices. Here is where the scientific approach enters the picture. It questions everything and insists upon the use of trained specialists who can get to the very root of a problem, analyzing it in all its details and then finding ways and means of bringing about improvement.

J. T. Loree, vice-president and general manager of the Delaware & Hudson, in speaking before the New England Railroad Club, commented upon some of the commonplace things in railroad service and operation that we do not thoroughly understand and that should be subjected to intensive study, in order that more efficient equipment and facilities be provided. An article, elsewhere in this number, includes those parts of Mr. Loree's address that are of special interest to mechanical department officers and supervisors.

Fortunately the Association of American Railroads has recognized the need for engineering research, and L. W. Wallace, who is specially well equipped for the service, is director of equipment research. Excellent progress is being made in studying and analyzing a number of problems related to the mechanical department, the most important of which is air conditioning.

It is important that the railroad executives understand the full purport and value of such work and that no effort be neglected in supporting and stimulating it, so that early and adequate results may be available. It is true that the railroads and the railway supply companies have done a great amount of research, which has made it possible for them to reach their present advanced status and yet, as Colonel Loree pointed out in the article referred to, and as Mr. Wallace has continually emphasized, there is a vital and compelling need for more intensive, well organized, engineering research in the railroad field.

Mechanical Supervisors And Public Opinion

As we see it, one of the primary obligations of railway mechanical department officers and supervisors in 1937 is to overlook no opportunity of supplementing their normal duties by helping to create a more favorable public opinion towards the time-tested institutions of this country and towards the railroads which are so essential to its prosperity.

Acute problems in human relations, as well as mechanics, confront the railroads in the New Year, and

the surprising thing is how many of these problems are not new but have been handed down from generation to generation. In the mechanical field, for example, men thought that they settled the question of taper versus cylindrical-tread tires over 50 years ago, but out it crops again in connection with light-weight high-speed trains. At least one important railroad in this country uses left lead steam locomotives, and, in all probability, few if any locomotive designers, even on this road, can explain how the practice originated and why it is still followed.

Similarly, in the field of human relations, difficult problems are particularly likely to recur. An aggressive minority is spreading the doctrine that there is no real equality of opportunity in this country and that all large corporations, including railroads, banks and other business enterprises are organized to oppress their employees and wring profit from the general public. Is this a new sentiment? Well, hardly! In 1838 Daniel Webster said in the United States Senate:

"There are persons who constantly clamor. They complain of oppression, speculation and pernicious influence of accumulated wealth. They cry out loudly against all banks and corporations, and all means by which small capitalists become united in order to produce important and beneficial results. They carry on mad hostility against all established institutions. They would choke the fountain of industry and dry all streams. In a country of unbounded liberty, they clamor against oppression. In a country of perfect equality, they would move heaven and earth against privilege and monopoly. In a country where property is more evenly divided than anywhere else, they rend the air shouting agrarian doctrines. In a country where wages of labor are high beyond parallel, they would teach the laborer he is but an oppressed slave.

"Sir, what can such men want? What do they mean? They can want nothing, sir, but to enjoy the fruits of other men's labor. They can mean nothing but disturbance and disorder, the diffusion of corrupt principles and the destruction of the moral sentiments and moral habits of society."

As good citizens mechanical-department officers and supervisors have a definite duty to combat this sort of propaganda, so wide spread now and so accurately described a century ago.

It is equally important to fight anti-railroad propaganda and, whenever opportunity offers, point out how closely national prosperity is tied up with railroad prosperity. A much more favorable public sentiment towards railroads has been achieved in recent years, but there is urgent need for still further improvement. In discussing this subject before the October meeting of the Western Railway Club, T. W. Evans, vice-president, New York Central, quoted from an editorial "Cultivating the Public" in the current issue of *Railway Mechanical Engineer* and said:

"On one hand we have the public demanding lower freight and passenger rates; on the other, the employees, through their representatives, are demanding higher wages, improved working conditions and, in addition, trying to have enacted such legislation as the six-hour day bill, train-limit bill, full-crew bill, track- and bridge-inspection bill, signal-device bill and train-dispatching bill, all of which, if enacted, would impose additional costs on railroad operation to the amount of 450 million dollars annually."

No one has yet discovered a way to "have his cake and eat it, too." The meagre earnings of most railroads, especially in the last few years, is a matter of public record. Many roads are now insolvent or facing bankruptcy. In numerous instances, necessary new equipment is being purchased with money secured from the national government because the credit of the railroads involved is not adequate to attract private capital. Probably few railroad officers are unsympathetic with the desire of the railroad brotherhoods for more jobs for railway men, but how, in the long run, they expect to attain this end by saddling railways with increased costs which will handicap them in competing with other forms of transportation and tend to drive traffic from the rails is something of a mystery. Mechanical-department supervisors, like supervisors in all other railroad departments, have a definite responsibility, insofar as possible, to bring a common-sense view of this situation to the attention of the rank-and-file of men who work for them.

Pertinent Suggestions on Car Repair Billing

In one of the most interesting programs held during the past year, the Car Foremen's Association of Chicago devoted its December meeting to a discussion of car repair billing. The principal speaker, C. J. Hayes, manager A.A.R. clearing house, New York Central, Buffalo, N. Y., brought to the meeting a wealth of practical knowledge and experience with car-repair billing which was supplemented by that of other car men in attendance.

The magnitude of general car-repair billing and the great amounts of money involved are indicated by the fact that, on the New York Central alone, Mr. Hayes' bureau handles 1,100 incoming and outgoing bills a month, which involves checking and pricing 161,000 repair cards and aggregates a monthly billing of $625,000. Operations of this magnitude always suggest the possibility of economy by a critical study and analysis of just how the work is being done, and it was the concensus of the meeting that five specific suggestions, advanced by Mr. Hayes, were worthy of thorough investigation with a view to being recommended as improved billing practice.

The five recommendations, which are of general interest, are suggested by the following questions: (1)

In view of the conditions under which billing repair cards are being prepared in train yards and classification yards, both by day and night and sometimes under highly adverse weather conditions, would it be practicable to have settlement made for such repairs in some other way in order to lessen the hardship on car inspectors and car repair men? (2) In view of the large number of defect cards issued covering repairs and minor Rule-32 damage that are not being used for billing, also considering the number of days which elapse between the date of defect cards and the date of repairs, would it be practicable to reduce substantially the number of such cards issued in order to lessen inspectors' clerical work and thus give them more time to devote to inspection for safety? (3) Can the reason for the large difference of wheel renewals on account of cut journals on cars of different ownership be ascertained, also the feasibility of making cut journals a delivering-line responsibility instead of a car owners' responsibility? (4) In view of certain apparent unavoidable errors that are being made in the preparation of billing repair cards and the pricing of such cards, would it be practicable to consider a car-repair bill correct, as rendered, when 99.5 per cent correct, per thousand dollars billed, in order to lessen correspondence and investigation of small overcharges and undercharges? (5) In view of the majority of billing clerks devoting much of their time to checking car repair bills for correctness of car numbers, charges, and footings should not a certain portion of their time be devoted to analyzing both incoming and outgoing bills in order to eliminate the possibility of specializing in certain items of repairs?

The simplification of car-repair billing was the subject of an extended study by a sub-committee of the Arbitration Committee of the Mechanical Division following the discussion of the Arbitration Committee's report at the 1931 meeting of the Division. A summary of the final report of the sub-committee on its investigation of three propositions was included in the Arbitration Committee's report presented at the meeting of the Division last June. The propositions investigated were the establishment of central or regional clearing bureaus to replace the present method of cross-billing among the railways, the elimination of all billing for freight-car repairs and the elimination of billing for repairs as between railways only. It will be recalled that the conclusions of the committee were unfavorable to any of the three propositions because of disadvantages in the loss of checking control and in actual increases in expenses which more than offset the direct reduction in billing expense which might be effected.

A most interesting comparison in the report was that between the estimated economies to be effected by the establishment of a central billing bureau as of December, 1932, and December, 1934, within which period immediate economies estimated at $15,000 per year were changed to immediate losses of approximately $46,000 a year, a difference brought about by decreases in costs following the general discussion at the 1932 meeting. This improvement the committee attributed to improved methods and increased efficiency.

This report would seem to settle for some time to come all questions concerning the desirability of continuing the present system of car-repair billing. It does not, however, preclude the possibility of finding and eliminating wasteful practices in the administration of this system. Mr. Hayes' second and fourth suggestions are particularly worthy of consideration from this viewpoint.

NEW BOOKS

WROUGHT IRON—ITS MANUFACTURE, CHARACTERISTICS, AND APPLICATIONS. *By James Aston and Edward B. Story. Published by A. M. Byers Company, Pittsburgh, Pa. 59 pages, 6 in. by 9 in., 29 illustrations. Price $1 but free copies may be had on request on letter-head of potential wrought iron users and faculties of engineering schools.*

The first two chapters of this small book contain a concise but rather complete history of early methods of manufacturing wrought iron and a discussion of a research made in 1915 for ascertaining the structural characteristics and chemical composition of specimens of good quality wrought iron made prior to that date. Chemical analyses and abbreviated service data on more than 50 of these specimens are included in the book. After pointing out how the early processes of manufacturing wrought iron limited the production of this material, and prevented physical uniformity of the finished product, the authors relate how the research made in 1915 resulted in forming the basis for the development of present-day methods for manufacturing wrought iron in quantity lots of uniform physical characteristics. Paralleling the discussion of production methods, the authors point out that the feature of wrought iron is a matrix of high purity iron embedded with thousands of fibrous ferrous-silicate threads. They then relate how other ductile ferrous materials were developed while attempting to produce one with resistant qualities similar to those possessed by wrought iron, and they present chemical analyses and microphotographs of the materials for comparison with those of wrought iron. The fifth chapter of the book contains a complete discussion of the physical properties, chemical analyses, and structural features of wrought iron as observed under macroscopic and microscopic examination. Chapter VI is devoted to a discussion of such characteristics of wrought iron as resistance to corrosion; resistance to fatigue fracture; adherence and weight of protective coatings; weldability; and forming, threading and machining. The remaining chapters of the book discuss the principal applications for wrought iron, itemizing these applications in diverse industries and fabrication processes. The book concludes with a glossary of terms relating to wrought-iron manufacture and products.

THE READER'S PAGE

"Old Fogey" Gets After Williams

To the Editor:

I can usually agree with the conclusions of most of the contributors to the *Railway Mechanical Engineer,* which is the most interesting and informative trade publication I can obtain.

But from a study of the several articles by F. H. Williams in recent issues, I am inclined to think these will become the cause of much needless and unwelcome grief and worry for many railroad men, who already have plenty of a kind they like to meet and remedy. But his "straining at gnats and swallowing camels" idea is questionable. Certainly, the study of the cause of fractures of certain locomotive parts is of great interest, and much valuable data may be secured in the shops for the steel manufacturer and the metallurgist.

Still it is almost as hopeless as it is ridiculous to line up the machine-shop foremen and the lathe operators and dramatically point to some tool mark or scratch and exclaim, "There is the cause of the fracture occurring to the main axle of engine so and so last month," when the same men know that, if such was the cause, scarcely an engine on any railroad would go six months without some part failing.

The steel men must look further than the machine shop for the real cause of their troubles and produce a metal such that a slight tool-mark scratch or indentation will not ruin a $150 axle. Practically every failure coming under my notice for the last 18 years has occurred where the part has been under great external compression, whether axles, crank pins or piston rods, the fracture occurring from one-half inch to one inch in from the inside face of the wheels, and about the same distance inside the largest diameter of crosshead fits. Whether the fractured section had been ground, polished, rolled, or showed slight file marks, legitimate lathe tool marks, or scratches, there was no noticeable difference in the break, nor in the mileage run before the fracture occurred. And my belief is that this pressure has something to do with the trouble.

To go about the modern day machine shop exhibiting the file marks on a metallurgist's watch (see page 483, November issue), insisting that better work be performed on axles and crank pins than was done on his watch, while attributing the cause of a broken crank pin to a lathe tool having either an incorrect cutting angle or having been improperly set seems rather far-fetched, especially when the photo submitted shows plainly that under the "microscope" the steel was of a very coarse structure and improperly annealed.

It would be a difficult matter to make a good machinist, such as is always used on the class of work in question, believe that if he had used a tool properly set up, carefully adjusted to the correct height for that "special material to be machined", the pin in question would not have broken.

No, Mr. Metallurgist, while we in the shop will go along with you and help you with our naked eyes to produce a metal that does not require to be machined under a microscope, and carefully wrapped up in woolen cloth while being handled at the press by careful men who must not wear rings on their fingers for fear the finished parts may be scratched thereby, we'll do our best with the finish on our radii, and be on the lookout for the first axle, crank pin, or piston rod to break at any of the radii we have already turned out on which scratches show.

I also believe that depending upon the roller to improve the conditions complained of is open to considerable debate. I have found where the roller was being depended on to eliminate scratches, but doubt if the job was improved by that method.

Old Fogey from Frisco.

If I Could Build My Own Round House

To the Editor:

When any one mentions a modern roundhouse it instantly brings to mind a number of conveniences, well known and well advertised, which lighten the work and speed up the handling of engines. It is not my purpose to belittle in any way these splendid features. However, there are other factors to be kept in mind in a new layout which can make or break the most elaborate plan.

Take drainage, for example. Main line tracks and yards have a habit of creeping upward as years go by. The section men ballast a track here and raise a repair yard there to match it, but the roundhouse and turntable must stay at the same old elevation. After some 30 or 40 years the surrounding property is a couple of feet higher than the turntable pit. In the spring the rains wash over the walls and clog the sewers. In the winter ice forms about the roundhouse doors with dire results. How much better to have started the house a couple of feet high in the first place.

The track layout is too often left to the engineering department with a mania for stretching things out. I know of no reason for making an inbound track over 500 feet long except in rare cases. If the extra room must be had, build two cinder pit tracks. It will save much shoe leather for the foreman as well as the hostlers. The outbound trackage should have plenty of spurs for holding engines called and awaiting calls without having to juggle them around.

The turntable will cost the most of any individual item, and properly so. The best is none too good. It should be as long as the budget allows and three-point suspension, of course. But even the most expensive machinery avails naught when the electric power fails and an arrangement should be provided for operating with an air motor on short notice; this is slow but effective. The same holds true for the coal dock and cinder conveyor. Two forms of power should be furnished in case of interruption of electric service.

The roundhouse itself should have at least two tracks lined across the table from inbound and outbound tracks. These are for handling dead engines. The machine shop and storeroom should be near these tracks and as close to the center of the house as possible.

Now for the foreman's office, if any. Some mighty fine terminals have their foremen located clear back somewhere around the machine shop. No doubt that is a comfortable place to be in the winter, but there is more going on at the cinder pit. If he can see an engine when it comes in he can judge pretty well what its chances are on the return trip. Personally I believe the proper place for the roundhouse foreman is as close to the inbound track as possible. The dead work in the house will take care of itself, but when things happen on the pit or outbound tracks they happen fast.

J. E. Kloss.

General Foreman, N. Y., C. & St. L. R.R.

Gleanings *from the* Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

Car Journal Lubrication

Why do railroad companies and car builders stick to the present method of car journal lubrication, which is about as crude as it was 50 or more years ago, while they have been constantly improving other car appliances?

Lighting Facilities Inadequate

A clean shop is necessary in order to provide safe working conditions and a healthy atmosphere for the mechanics to work in, thereby producing better work; especially so if the lighting facilities are adequate. In many shops lighting of the machine bay is deficient and could be improved upon; this would not only mean a greater degree of safety for the employee, but also increased output.

Take Advantage of Better Cutting Steels

Railroad shops are not keeping up with the times. The introduction of the new cutting tools has revolutionized shop methods, particularly in the last three years. It is not necessary that railroads purchase new single-purpose production machines; the present machines can be speeded up to the capacity of tools, such as Stellite, and if properly ground the capacity of machine can be more than doubled, the point being to get proper finish with one cut.

Cranes For Each Machine

Another thing that I have had in the back of my head for some time is just this: If I were purchasing machine tools I would specify an individual crane for each machine. There is no way to estimate the time lost in waiting for overhead cranes to serve machines, especially in large shops. The overhead cranes should be used to place the material at the machines and take it away after it is finished. I have installed these individual cranes on several machines and these installations have proved a good investment.

Obsolete Machines Costly

I often wonder how shops like the———, with all the old obsolete machinery, can possibly make any money. They have a lot of old driving wheel lathes in their wheel shop; two or three modern wheel lathes will do as much work as all the 12 or 15 machines they have will do. You can take the average railroad or locomotive builders' plants and throw away over half of the old, worn-out machines and install one-fourth the number of good, up-to-date machines and increase production about 25 per cent. We see crossheads being planed on old, slow-motion planers. They may turn out six or eight per day, but an up-to-date milling machine will mill these at the rate of two per hour and use only about one-fourth as much floor space.

Safety Signs

As to "signs of safety" I think Walt Wyre has put forth a lot of good food for thought. It is an old saying, and I believe a true one, that "familiarity breeds contempt," and merely posting a lot of safety signs is not going to promote safety, as these signs soon become so familiar that the men pay little attention to them. I think that the best method of promoting safety is for the supervisors, through personal contacts with the workers, to convince them that they are personally as much responsible for getting hurt as they are responsible for putting up a bad job, and I usually have found where those points are driven home they have a pretty good safety record.

When Basford Was Editor

I can remember, way back when I first started railroading in 1903, that I found located in various places throughout the offices, loose copies of the American Engineer and Railroad Journal (now *Railway Mechanical Engineer*) from dates of 1896 to 1901. These papers contained a wealth of information which to me at that time was priceless, and I still have the clippings removed from these early magazines. Quoting from memory, they contained articles by Cole, Grafstrom, Henderson, Forsyth, Mellin, Pomeroy, Quayle, Goss, Vaughan and Vauclain, and of particular value was a series of articles on locomotive design and construction by Mr. Cole. Strange to say, these articles, although written over 30 years ago, contain considerable data suitable for present-day use. Of course, at that time we were in a more formative stage than we are now, and many matters could be written about which are now accepted as commonplace.

Concerning Engine Failures

Mr. Williams' suggestions and findings in his articles on engine failures are in line with recommendations that have been made by our own laboratory people. More and more as our trains are speeded up, we have found it necessary to tighten up, not only on the quality of the material used, but also on the methods of handling, and we are constantly consulting with our mechanical engineer's office and the laboratory as to what may be done to improve the performance. In addition to all of this, we call a monthly staff meeting of all master mechanics, where each engine failure is thoroughly discussed and a decision reached, as nearly as possible, as to what caused the trouble. A report of this meeting is then mimeographed and every foreman on the railroad, no matter how small the terminal, is furnished a copy of this analysis of our engine and motor-car troubles, in order that everyone may get the benefit of these meetings.

Efficient Handling of Portable Tools

Several years ago when we were about as busy here as any shop in the country and were doing as much work as any shop of its size, we discovered that a lot of time was lost in getting portable tools ready for a job—boring bars, facing machines, portable grinding and milling machines, valve-seat facing machines, and other tools. The parts were scattered all over the shop and it took longer to find the tools and put them in shape than it took to do the job. Here's our solution. We built six or eight special trucks; we mounted the large cylinder boring bar on one truck and attached a steel box to the rear of it; in this box we put all the small tools, wrenches, clamps, etc. The tool-room foreman had a key to the box, as did the erecting-shop foreman. When the boring bar was removed from the cylinder and put back on the truck, it was sent to the tool room and the tool room foreman had the bar inspected, all repairs necessary made and the truck placed in a building where it was parked until needed. We have two large roundhouses and an erecting shop here; whenever any of the portable tools are needed the foreman in charge simply calls the truck dispatcher and tells him to take the cylinder boring bar to the place designated and the bar is placed at the engine where the work is to be done, with motor and all equipment ready to do the job. Compare this with the old method and see how much time is saved. I wonder how other shops handle this proposition.

With the Car Foremen and Inspectors

Gaging Cast-Iron Wheels*

By H. B. Atherton

Inasmuch as the A.A.R. rules do not permit us to remove a wheel from a foreign car and render the bill against the car owner until some defect has developed to a definite point, we must assume that the wheel is perfectly safe until that point is reached. Therefore it seems reasonable to assume that the wheel is still safe even when that point has actually been reached.

Now I do not advocate permitting any wheel to remain in service with any defect that has reached the condemning limit, but am merely bringing out that point because when we remove a wheel because some defect is "awfully close" to the limit, we are throwing away service because it requires 5,000 miles to wear 1/64 in. from the wheel.

There has been a tendency for a number of years to eliminate from the rules the so-called "judgment defects," and measuring devices have been developed to tell us when a wheel should be removed; but in spite of this, I believe that the inspection of wheels is the most particular job a car inspector has to do.

Car inspectors as a class are, in my opinion, among the most conscientious employees of the railroad. They realize their responsibility and endeavor to protect their railroad against accidents and at the same time prevent unnecessary delays to shipments, but it is possible that at times some of them may be a little technical when inspecting a bad-looking wheel and, to play safe, card it to the repair track where it can be inspected under better conditions. If the wheel is actually questionable this, of course, is the proper thing to do; but if it is a case of improper gaging, it is decidedly wrong, because the time consumed in moving a car to and from the repair track usually causes it to miss schedule, often resulting in a dissatisfied shipper, to say nothing of the switching cost involved, which averages about $4.

Wheels account for the heaviest single item of expense in connection with car repairs and too much attention cannot be paid to this matter.

Rule 68.—This rule provides that flat sliding wheels should not be removed until one spot at least 2½ in. in length or two or more adjoining spots, each 2 in. or over in length, have developed. In gaging slid spots, the gage should be placed on the spot parallel with the flange and not turned to cover the spot cornerwise. The length of the spot must be considered as running parallel with the flange and must be of the limiting length in this direction, even though it may be in excess of the limiting dimension when measured at right angles with the flange. It will be noted that where two or more 2 in. spots have developed, at least two of them must be in contact with each other. Slid spots are caused by raising the temperature of the tread to about 2,000 deg. due to friction on the rail when the wheel stops turning, and a spot ¾ in. by 1 in. can be put on a wheel in about 10 ft. under capacity load. A spot this size removes 1.1 lb. from a wheel under a 50-ton car.

Rule 71.—The same method of gaging shelled-out spots, of course, is to be followed, as in gaging slid spots, but care should be used to distinguish between shelled spots and brake burn, the former having somewhat the appearance of an oyster shell, while the latter is made up of a number of cracks close together running crosswise of the tread.

Rule 72.—Seams as defined in Rule 72 are probably the most dangerous defects of all, and when any seam is discovered within 3-¾ in. of the flange, the wheel should be removed from service.

Rule 73.—Worn-through chill spots are found in wheels of low or shallow chill. When the chilled metal wears through, the softer metal underneath shows a gray, mottled color. If the tread has flattened, it can be determined by drawing a straight-edged piece of metal along the tread with one end of it in contact with the flange and the mark on the wheel left by the piece of metal will show a bow or arc.

Rule 74.—Under wet weather conditions it is sometimes difficult to determine whether a vertical flange has reached the condemning limit, and the easiest way that I know of to determine this is to use ordinary soft white chalk to whiten the worn surface of the flange. Then place the gage upright in the proper manner and move it a short distance along the flange. If the indicating point on the gage does not leave a mark in the chalked surface of the flange, the wheel should not be removed, even though the destination of the car is 1,000 miles or more away. Care should be used in applying the gage to thin flanges to be sure that it is not tilted but is held as level as possible.

Rule 75.—Brake-burned wheels are caused by raising the temperature of the tread about 1,400 deg. and are often caused by conditions beyond the control of the car department; but a defective triple, or retainer, or a set handbrake can accomplish this in less than half a mile. These same causes can also slide a wheel; so it is therefore of the greatest importance to know that the air brakes are working properly and that there are no handbrakes set on cars leaving terminals; and trainmen should know that brakes are released on cars picked up at way stations. The same method of gaging applies, as in the case of slid flat wheels, except that care should be used to determine whether any cracks over 2-¾ in. have developed or any cracks are in the flange or throat.

Rule 76.—Figure 4-D, Rule 76, shows the proper

(Continued on page 38)

* Abstract of a paper presented at the November meeting of the Chicago Car Foremen's Association. Mr. Atherton is car foreman of the Chicago Great Western at Chicago.

CAR FOREMEN Have

DICK WHEELER, car foreman for the S. P. & W. at Plainville, stamped his feet on the door sill to shake off the snow. When he opened the office door the little room seemed colder than it was outside despite the fact that heavy, black smoke was pouring from the chimney on top of the office. Wheeler opened the caboose stove door. Just as he expected, a heavy wad of old packing, weighted down with a layer of coal, was smouldering in the stove.

"Might be a good way to smoke out mosquitoes, but a damn poor way to build a fire!" Dick commented as he gave the waste air by lifting it with a packing hook that served as a poker.

After some manipulation and coaxing, the fire gave signs of coming to life. The car foreman sat down at his desk to look over the mail before time for the men to start to work. As he read the letters, he began to frown, frowning more as he read: "—entirely too much overtime, too many hot boxes, too much delay getting trains through the terminals, too much car oil being used. No excuse for the steam heat line freezing up on the Limited. Twelve stock cars needed immediately—"

Wheeler finished the mail, glanced over the latest lineup, and went over to take another poke at the fire in the caboose stove. "Too much car oil!" he snorted, "and the packing so dry it won't burn! No wonder we have hot boxes!"

"What seems to be troubling you?" Ed Williams, the yard clerk, asked as he came in to warm his hands.

"Oh, just doing a little private bellyaching. They keep hollering about too much oil and too many hot boxes. Why, there's not enough oil in a handful of the packing we get to make a greasy spot on a white shirt!"

"Yeah, they're never satisfied," Williams replied.

"I don't mind getting et up if I'm at fault," Wheeler replied, "but the master mechanic give me a trimmin' over the steam heat being froze up on the Limited night before last, when he knows it came in froze up. It's not my fault if the train crew goes to sleep on the job. Then when I work a couple of men an extra hour to get the train out with as little delay as possible, I catch thunder —too much overtime!"

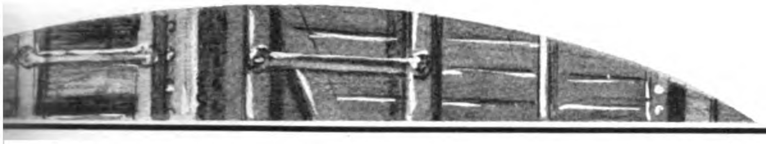
"Well, I've heard there would be days like that," Williams consoled as he left.

Wheeler took a turn around the rip to see what had accumulated the night before. A wooden gondola with the draw-bar yanked out, a couple of automobile cars with wheels to be changed, a caboose calling for weather stripping of doors and windows, and a miscellaneous collection of others needing everything from brake beams to deck, siding and roof. A reefer on number three track was squatting slightly on the left side of the A end. Dick knew without reading the card it was a broken arch bar.

As he circled back to the office, the car foreman mentally assigned men to the various jobs.

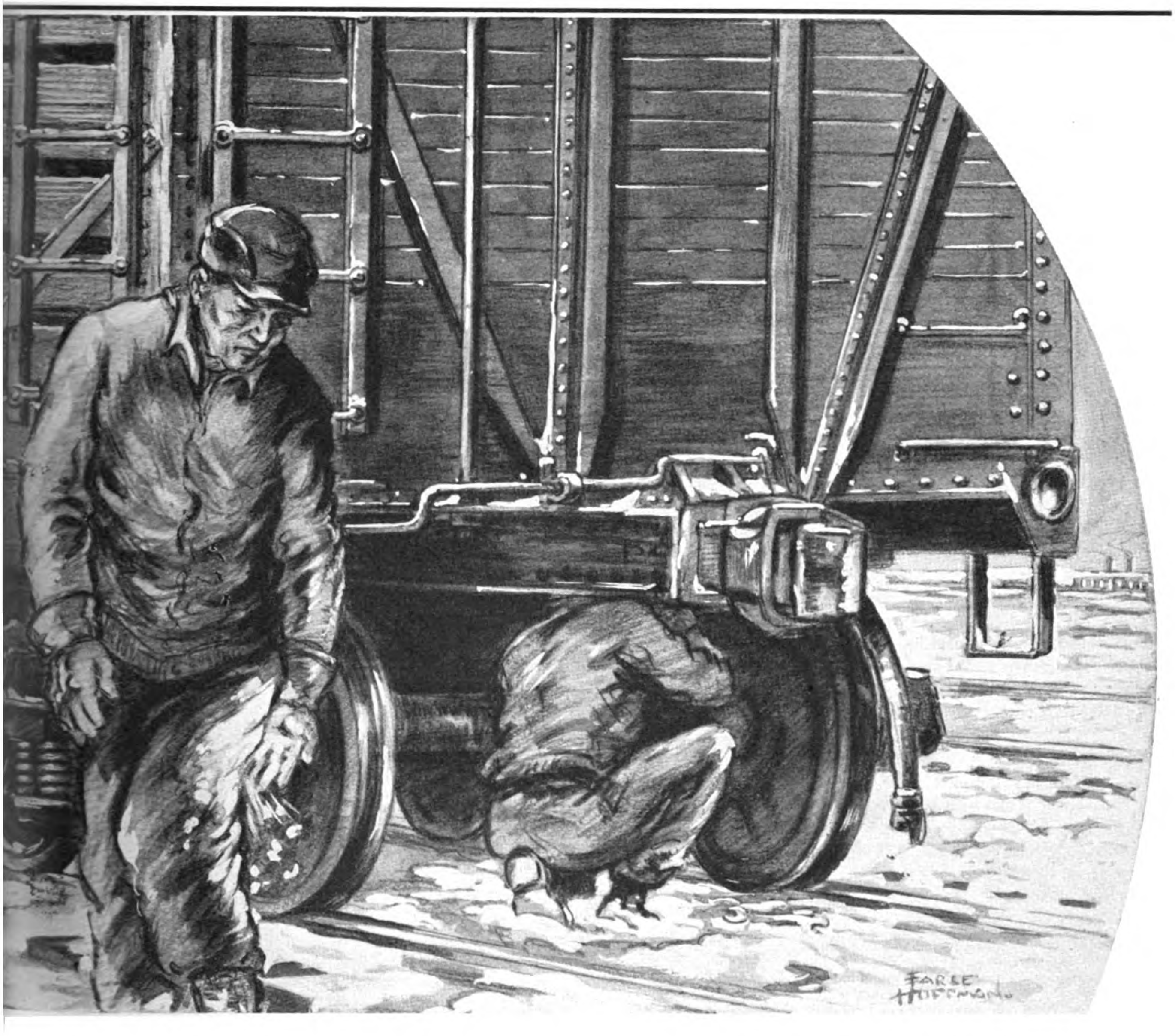
AT eight o'clock the carmen and their helpers trudged out in the snow to their various jobs. Two or three more fortunate than the rest caught jobs in the car shed where the snow only lay in patches. The flock of sparrows that used the place as shelter made it inadvisable for a person to have his mouth open when he looked up. Tom Blake, who served in the army during the World War, said if the Allies' bombers had been as accurate as those sparrows the war would have ended six months sooner.

Jake Miller and his helper went to work replacing the broken arch bar on the reefer. At least that was their intention. The first hour they put in locating a jack that would work and wasn't in use. The car foreman



Troubles Too

by **Walt Wyre**



Whoever nicknamed carmen "dusty butts" should try a little of this! Thompson replied as he brushed the wet snow from his nethermost extremity

came by as they were setting the jack under the car.

"Trainmaster just called. They're in a helluva rush for this car. Want to get it on 72," Wheeler said.

"Yeah, you might tell him he would speed things up more by getting a couple of new jacks than he will sittin' on his fanny and yellin'," Jake replied.

"I'll write the master mechanic about getting some of our jacks sent in for repairs," Wheeler told the carmen.

EVERYTHING seemed to be going as well as could be expected on the rip. Wheeler went back to the office to work on reports. He had just settled down when the phone rang.

"Have to have two more cabooses; one for a work train and another for an east turn," the trainmaster told him.

"The only two extra cabooses we've got are a couple of old wooden ones that need a lot of work before they'll be fit for service," the car foreman told him.

"Can't help that; we've got to have them."

"One of them will have to have a new end sill, and—" A click in the phone told Wheeler that the trainmaster had hung up.

The car foreman again waded out in the snow. He

went over to where Bill Thompson and Art Horton were working on stock cars. Thompson was sitting in the snow working on a brake beam.

"How you coming?" Dick asked.

"O.K. I guess; but whoever nicknamed carmen 'dusty butts' should try a little of this!" Thompson replied as he brushed the wet snow from his nethermost extremity.

"Let this go and put a new end sill in the crummy on No. 2."

"That Noah's ark? I thought it was set aside. Where am I going to get the end sill?" Thompson asked.

"Have to make it, I guess," the foreman replied as he started over to tell Horton to start work on the other caboose.

WHEELER went back to the office and again started to work on his reports. Again the phone interrupted.

"How you coming on that reefer?" the dispatcher wanted to know.

"I'll see—"

"We want to get it on *72* without fail. It's loaded with lettuce, you know," the dispatcher reminded.

"Yes, I know. I'll push it," Wheeler replied.

The car foreman found Miller and his helper at the blacksmith shop waiting for the blacksmith to make the arch bar. The broken one lay on the floor, a length of iron for the new one lying beside it.

"What's the delay?" Wheeler asked.

"Had a lot of work for locomotives," the blacksmith replied. "Be another hour before I can get on that arch bar unless the roundhouse foreman says different."

Wheeler located Jim Evans, the roundhouse foreman, and persuaded him that the arch bar was just as important as some of the other work, but lost twenty minutes doing it. It was almost noon when the arch bar was finished and ready to be drilled.

Miller and his helper carried the arch bar down to the car-department mill to drill it. The carman was willing, but the drill wasn't. The clutch wouldn't hold at low speed and the machine ran too fast in high. Wheeler came in while they were trying to drill the arch bar. He stood and watched a moment.

"Can't you make it work?" Wheeler asked.

"No," Miller said. "If the blasted drill hadn't been worn out, they wouldn't have given it to the car department in the first place. They'd have kept it at the roundhouse."

"Try it in high speed," the foreman suggested.

"It runs too fast," the carman said as he shoved the lever over.

"Keep plenty of soapsuds on it. Maybe the drill won't burn up," Wheeler advised.

The drill bit into the iron with a chatter as the point took hold. The shavings flew; then, as the lip of the bit dug in, it stopped. The belt was slipping. After fifteen minutes spent trying to persuade the antediluvian machine to function, the car foreman gave up. "Take the blasted thing to the machine shop."

"The drill-press man is snowed under. I looked before I brought the arch bar down here," the carman said.

"Well, tell Evans I said to have him drill it noon hour," the foreman replied. "You fellows had better stay with it and get it put on. The dispatcher will have epilepsy and the trainmaster too if we don't get that car finished in time to go on *72*."

The twelve o'clock whistle blew before Wheeler reached the office. He called the dispatcher to get the latest dope on when the eastbound Limited would arrive. The dispatcher told him about 1:15, forty minutes late that made it.

"Hope it's not hot boxes on the cars," Wheeler reflected as he wrestled out of his heavy sheep-lined coat.

THE Limited pulled in at 1:35, and it was hot boxes that had caused the delay. Wads of frozen packing blossomed from around the lids of several boxes. The acrid odor of hot car oil assailed the car foreman's nose.

The two car inspectors got busy as a barefoot boy in an ant bed when the train slid to a stop. Wheeler grabbed a packing hook and pitched in. Three boxes had to be repacked. The trainmaster, superintendent, master mechanic, and conductor took turns making suggestions. The conductor looked at his watch every fifteen seconds, always holding it so the superintendent couldn't help seeing it. About the time the car foreman and the inspectors reached the tenth car, the chief dispatcher joined the audience. He had a watch, too. In fact, the proceedings were well watched and well timed, even if some of the offside remarks weren't. The train had lost seven more minutes over and above its regular dead time in Plainville when the conductor raised his hand.

"How you getting along on those cabooses?" the dispatcher asked when the Limited was on its way.

"Oh, pretty well, I guess. It's going to take a lot of time to make an end sill with the facilities we have," Wheeler replied.

"You've got a power saw and drill press," the master mechanic reminded.

"Yeah, both of them worth their weight for scrap. That's where they must have been headed when they were diverted here." Wheeler said it in a manner obviously intended to be joking, but it was equally evident that he meant it.

"We've got to have those cabooses tomorrow," the trainmaster chipped in as the car foreman started back towards the rip.

The first thing the foreman did after getting back to the rip was go to the mill to see how Thompson was getting along with the end sill for the caboose. The carman wasn't doing so well or rather the saw wasn't, which amounted to the same thing. Thompson was attempting to rip the heavy timber on the antiquated rip saw. The old saw had other ideas. First, the belt slipped; belt dressing helped some, but not enough to make the saw operate. The carman cut a piece out of the belt.

When Wheeler came in the mill he found Thompson sweating and swearing. He had sawn about one-third of the length of the timber by cutting a little way, then stopping and cutting some more. The saw mandrel was sprung, causing the saw to wobble so much that the cut looked as though it might have been made with a plow plane.

Wheeler heard the high-pitched whine of the saw before he entered the mill room door. The note became lower and lower, changed from a whine to a harsh rasping sound that ended with a grunt as the saw stalled in the timber and the belt came off the pulley.

"Maybe the saw hasn't got the right set," Thompson's helper suggested.

"I know damned well it hasn't. It should be set in a junk yard some place. Shut off the motor and put the belt back and we'll gouge another nick." The carman was exasperated.

Wheeler came in just as the saw stopped. He looked the situation over and left without saying anything. He did make a mental note to invite each of the division officials in to look over the obsolete machinery and suggest how he could be expected to do a decent job with it. Perhaps a demonstration would accomplish what letters had failed to do.

On the way back to the office Wheeler met Dint Robinson, a car inspector. "Stock car got to have a pair of wheels changed," the inspector panted.

"Well, card it and the switch engine will set it in the rip."

"That's just the trouble," the inspector said. "The switch engine ain't working and the car is already set to load."

"Can't they load another car?" Wheeler asked.

"Ain't no other car. They're figuring on starting to load about 6:30. The cattle are getting out on an extra at nine o'clock."

The car foreman pondered the situation for a moment. The switch engine tied up at two o'clock and wouldn't be back on again until eight. That would be too late to set in another car at the stock yard. "What's the matter with the wheels?"

"Chunk broken out of the flange. It's a C. T. & W. car. Came in over the interchange with that bunch last night," the inspector told him.

Wheeler groaned. "That helps a lot. Is the car setting so we could get to it to change the wheels there?"

"Yes, it's the last car on the east end of the stock-yard track at the chute. The bum wheel is on the east end of the car, too," the inspector added.

"O.K., I'll see if we've got a pair of wheels. As you go back, stop at the car shed and tell Wilson and Monroe to load a couple of jacks and some tools on a push car. I'll start a couple of laborers over with the pair of wheels."

There was a pair of wheels at the storeroom. Two laborers set out rolling them up the north passing track. The carman followed with a push car loaded with the necessary tools. Wheeler decided to take another whirl at making out his reports and answering some of his correspondence. He worked perhaps twenty minutes when Tom Blake came in, a journal brass in his hand.

"What's the trouble now?" the foreman asked.

"This brass," Blake said, "Look at it."

Wheeler looked. The babbitt, brand new as far as service was concerned, was battered and dented. One spot in particular showed a deep triangular dent. "Better get another."

"They've only got one more of this size in the storeroom," Blake replied, "and it's worse."

"Must be in pretty bad shape then. I can't see why the store department don't do something to prevent damage to brasses in handling. I'm going to write it up again."

"What do you want me to do with this one?" the carman wanted to know.

"Smooth it up the best you can and use it," Wheeler told him and turned to his office work.

When five o'clock came, Wheeler was still two-fingering the battered typewriter, working on reports. The correspondence was still waiting together with some left over from preceding days. Most of it would have to wait until Sunday to be answered while he was resting.

The car foreman finished the report on which he was working and decided to go to the stock yard and see how the boys were getting along with the pair of wheels. On the way he stopped at the mill to see about the caboose end sill.

The sill was there ready to be drilled. The piece of timber sawed from the sill told why progress had been so slow. At least half the length of the timber had been sawed by hand. Jagged places, burned spots, and saw marks told the story of numerous starts and as many stops before the carman had finally given up and resorted to hand power to rip the heavy timber.

At the stock-yard Wheeler found the work progressing fairly well. The boys had removed the bad pair of wheels and rolled them to one side so the new pair could be rolled in place.

"More overtime to be explained," Wheeler reflected. "Roll the old pair of wheels out where no one will stumble over them and leave them till morning. And be sure the packing is in good shape on these." The foreman indicated the pair of wheels being put in.

"You look kinda tired," Mrs. Wheeler said when the car foreman got home. "Have a hard day?"

"Oh, not so bad," Wheeler replied. "Supper ready?" he added.

"Just about. It'll be ready by the time you can shave," his wife replied.

"What's the idea wanting me to shave?"

"Oh, I thought we might go to the picture show," Mrs. Wheeler replied. "Wouldn't you like to go?"

"You and the kids go ahead," he replied. "I've got to go back to the office and finish my reports. Want to write a couple of letters, too."

"It'll do you good to go to the show. Can't the reports and letters wait until tomorrow?"

"Afraid not," Wheeler replied, "you see, the reports were due day before yesterday and I want to write the letters while they're fresh on my mind. I'm getting fed up on the car department being used as a dumping ground for machinery worn out by the mechanical department. I wish I had a sound picture of Thompson trying to rip that piece of timber this afternoon to send along with it," Wheeler laughed.

"It wouldn't be very funny to me," his wife cut in.

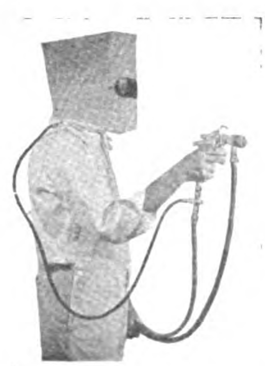
"Might as well laugh as cry. There are two kinds of foreman that stick on the railroad. One does the best job possible, catches hell for it, and likes it. The other does the best job possible, catches hell for it, and don't like it."

"Well, I wouldn't like it," his wife said, "and I don't understand why you don't go to the show and forget it."

"No, not being a car foreman, you wouldn't understand," Wheeler replied. "Pass the biscuits."

Respirator Hood Without Vision Glass

A hood respirator designed for use in occupations where there is a fume or dust hazard which demands protection beyond that offered by the more common type of respirator, has been developed by The DeVilbiss Company, Toledo, Ohio. This respirator, designated by DeVilbiss as the type MPH respirator, covers the head and



Air introduced into hood respirator flows out through vision opening and eliminates need for vision glass

neck fully, and provides protection where ventilation is inadequate or against materials present in the air harmful to eyes, ears, or respiratory organs.

Air flows into the hood through a filter and flows out through the opening provided for vision, thus preventing outside atmosphere from approaching the eyes or entering the hood. Therefore, clear vision is provided with safety without the use of glass or other transparent material over the vision opening. The unit is composed of a lightweight headgear, air filter and air hose which is connected to the air line with a detachable connection, and a light-weight sanitary flame-proofed hood which is supported by the headgear. The hood, which is fastened around the neck by a draw string, is inexpensive and may be removed and replaced by a new one when it becomes soiled. The respirator is recommended for use in atmospheres containing offensive chemicals, nauseating vapors, particles of lint, paint spray, dirt or dust.

Lubrication Correction

A specially treated oil, known as Lubco, is now being introduced in railway service by the Lubco Corporation, Chicago, for use as a lubrication correction for hot boxes and new brasses. This new processed oil is said to lubricate railway car journals regardless of waste grabs or foreign material present in the box, clinging to the journals and brasses under all conditions of service. Scientific tests indicate that, by the use of the new oil, journal friction is substantially reduced, capillary action in wool and cotton waste increased and corrosive action reduced. Lubco is not a cooling compound, but a corrector of faulty lubrication conditions.

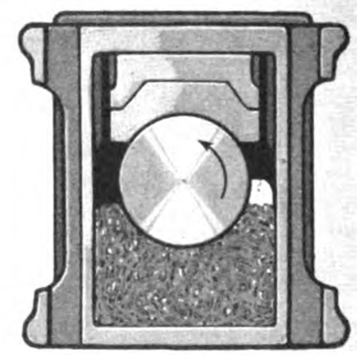
Lubco Hy-ball, particularly specified for the correction of hot boxes, is available in a handy kit, consisting of six emergency tubes of the processed oil, contained

Lubco Hy-ball train kit which may be applied on caboose-car walls or at any other convenient location

in a cardboard carton which may be kept on caboose-car walls, switch-shanty walls or wherever is most convenient for trainmen and car men. Advantages of this new lubricant include the conditioning of hot car journals so that they can be continued to servicing points without delay; elimination of delay and expense for setting out cars; avoidance of the necessity of service enroute when applied to new journals and brasses; reduction of friction, heat generated and power requirements; and the ability of the oil to maintain a film on the bearings in the face of heat, wiping or washing action and heavy loads.

When using Lubco in connection with hot boxes, the waste is cut back on both sides of the journal, the contents of the tube of Lubco being squeezed into the journal box near the rising side of the journal. With a packing iron or stick, the lubricant is forced as far back and as near the journal as possible, endeavoring to bring it in contact with the journal. No water or ice should be put in the journal box as this will only tend to flood the oil out of the box and contaminate the packing. Free oil may be added if necessary.

In connection with new applications, the brass is cleaned and the journal is washed with free oil. A light


Cross-section showing application of Lubco Hy-ball on the packing against the rising side of the journal

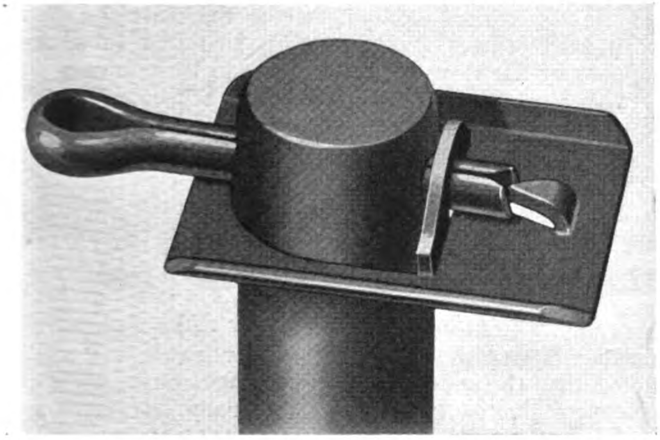
coating of Lubco is applied to the face of the brass and a small amount of oil added to the coating. The box is packed in the usual manner, adding about one-half the contents of a tube of Lubco to the packing as the latter is being applied. The balance of the tube is applied along both sides of the journal on top of the packing, applying free oil, if necessary, in the usual manner.

Lubco Hy-ball is available for the correction of faulty locomotive crank pin, guide, journal, valve and cylinder lubrication.

Perfection Cotter Lock and Guard

That the failure of such an apparently insignificant part as a cotter key presents possibilities of hazards and in fact actual derailments of railway equipment is not open to question. Cotters which are insufficiently spread have a tendency to vibrate and work out and excessively spread cotters may fracture and break off. With greatly increased operating speeds, railway equipment parts are subjected to more severe vibration than formerly and, in the case of cotters or split keys, end thrust and friction tend to shear and wear them off.

To meet these conditions the Illinois Railway Equipment Company, Railway Exchange Building, Chicago, has recently developed and placed on the market a Perfection cotter lock and guard which is shown in the illustration. This device consists of a simple stamping made of No. 10 cold-rolled steel, having a hole in one end to fit over the pin, a small vertical ange bearing against one side of the pin and drilled with a hole corresponding to the cotter hole and a raised triangular projection which splits the cotter as it is driven home. This construction definitely spreads and locks the cotter in a positive manner. The cotter and guard act as a



Method of applying Perfection cotter lock and guard

unit, wear being taken on the latter and the cotter protected against abrasion and failure. The cotter is easily revolved and reapplied.

The Perfection cotter lock and guard is available for all A.A.R. standard pin sizes and is recommended for all pins on new car construction as well as repair work.

Armco Galvanized Paintgrip Sheets

Commercial production of a galvanized sheet which is said to assure a good paint bond on iron and steel products has been announced by The American Rolling Mill Company, Middletown, Ohio. The product, introduced as Armco galvanized Paintgrip sheets, is the result of several years' research on the part of Armco's metallurgists and the technicians of the Parker Rust-Proof Company. It can be painted without special treatment of the surface.

The sheets are chemically treated to produce a finely crystalline phosphate coating which in itself is neutral to paint (being neither acid nor alkaline) and keeps the paint from direct contact with the zinc surface. This coating is an integral part of the sheet and is slightly granular in nature.

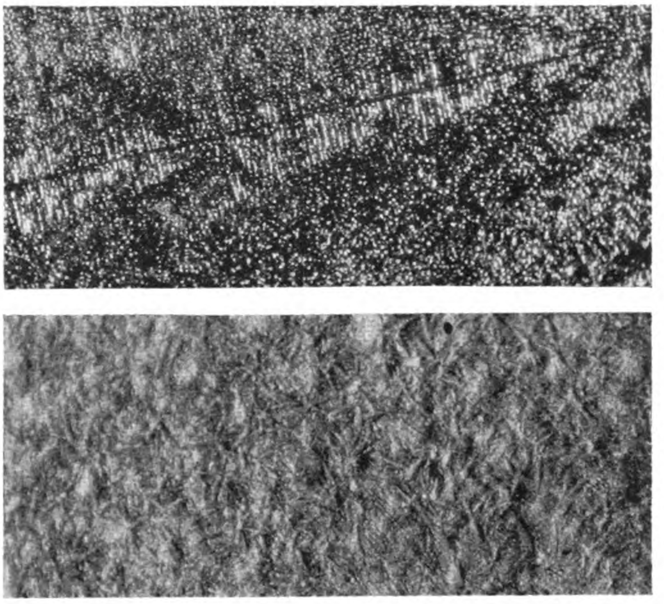
Armco Paintgrip sheets are available in any of the grades of galvanized sheets manufactured by the company. Analysis of the base metal can be that of Armco Ingot Iron, plain or copper-bearing steel. When it is required, all grades of these sheets can be supplied stretcher leveled.

Forming qualities of Armco Paintgrip sheets are the same as untreated galvanized sheets. They may be soldered with the use of hydrochloric acid as a flux. So-called "cut-acid" is not strong enough to penetrate the paint-grip film, which must be dissolved before a good solder bond can be obtained.

While Paintgrip sheets shipped from the company's mills are prepared to receive paint without further treatment, handling and fabricating operations in customers' plants will often necessitate cleaning. Organic cleaners such as naphtha, benzine and lacquer thinners are preferred. If alkaline cleaners are used, the paint-grip surface will be attacked and partly removed by their action. Because of its crystalline absorbent nature, the surface of a paint-grip sheet will tend to absorb a certain amount of the alkalies which are difficult to remove. Alkaline conditions under a coat of paint are considered one of the most common causes of early paint failure.

Practically any good paint can be applied to Armco Paintgrip sheets. If baked finishes are used, the paint manufacturer usually recommends a suitable primer. Any good baking system will be found satisfactory for Paintgrip sheets, provided the baking temperature does not exceed 450 deg. F. Higher temperatures are apt to be detrimental, particularly if the time of baking exceeds 15 min.

Formation of a paint-grip coating on metal is dependent upon the fact that phosphoric acid solutions

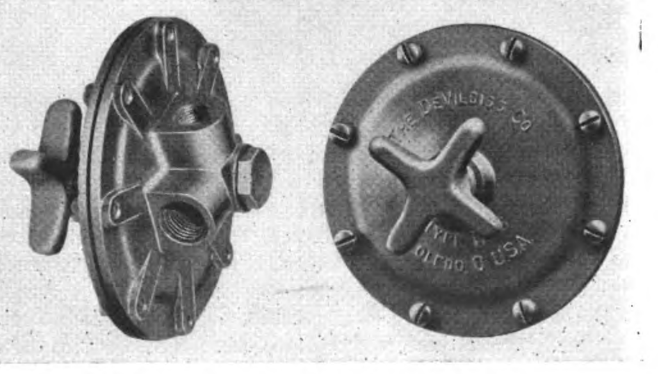


Above: Ordinary galvanized sheet—Below: Armco galvanized Paintgrip sheet. Magnification 40-diameters

will dissolve zinc phosphate within certain definite limits. Passing zinc-coated iron or steel products through such a solution results in the formation of the paint-grip coating which becomes an integral part of the metal surface at the point of solution. Reaction takes place with the evolution of hydrogen, continuing until the metal surface is completely converted to a crystalline phosphate coating.

Low Capacity Air-Regulator

A low-capacity regulator, designed for the sensitive regulation of air pressures below 30 lb. has been developed by the DeVilbiss Company, Toledo, Ohio. This unit, designated as the type HFS regulator, has a diaphragm 4 in. in diameter for providing a sensitivity



DeVilbiss regulator for air pressures below 30 lb.

approximately six times as great as that of the standard DeVilbiss regulator, the effective diaphragm diameter of which is generally only 1½ in.

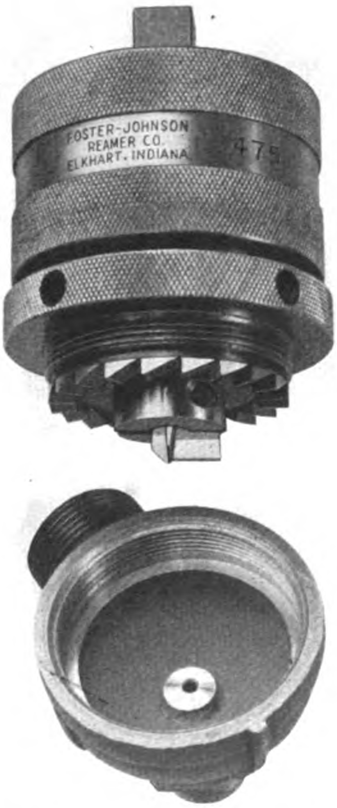
Regulated air pressure on the type HFS regulator can be graduated up to 30 lb. with but 1 oz. variation for each 10-lb. variation of main-line pressure. That is, a variance of 40 lb. in main-line pressure will cause only 4 oz. variation in the regulated air pressure.

The diaphragm is clamped in the regulator body between two brass castings fastened together by radially spaced bolts. Special valve design and construction prevent the valve seat from cutting into the rubber valve.

Reseating Tool

Reseating tool No. 475 has recently been developed and placed on the market by the Foster-Johnson Reamer Company, Elkhart, Ind., for use in reconditioning the diaphragm portion of airhead governors. The operations performed with this tool include facing the diaphragm shoulder, facing the shoulder for the needle valve seat and facing the needle valve seat.

As shown in the illustration, the tool consists of a main reamer guiding portion with a knurled exterior



Combination reseating tool effectively used in air brake repairs

surface which may be used to turn the threaded end firmly into the diaphragm portion and against a shoulder which accurately positions the tool. The other knurled portion of the tool is designed to provide hand feed for the reamer, which is turned by means of a wrench applied to the upper square end of the tool.

The reamer proper is a combination tool which faces the flat portion where the diaphragm and needle valve rest, maintaining the correct vertical distance from both shoulders. The tool also faces the angle of the valve seat in the same operation, leaving the seats concentric with each other. By the use of this tool subsequent lapping of the valve seat is said not to be required.

The No. 475 reseating tool, with a special No. 601 spanner wrench, is available for use in reconditioning 1-in., 1¼-in. and 1½-in. governor diaphragm bodies.

Gaging Cast-Iron Wheels

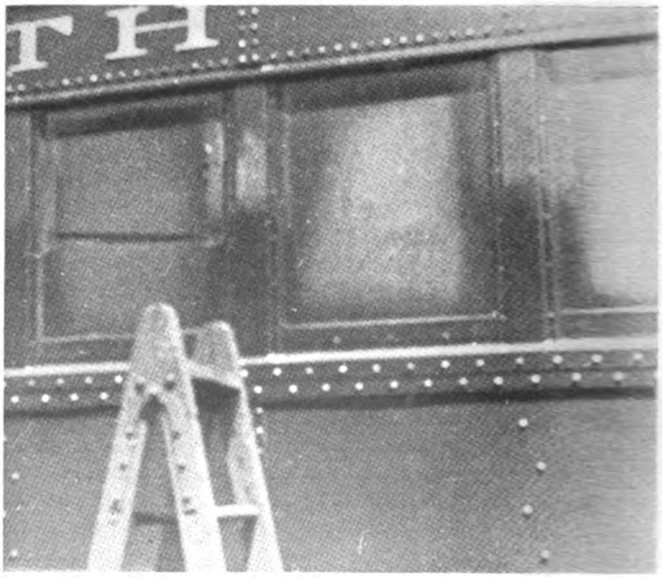
(Continued from page 31)

manner of gaging wheels with hollow treads. It will be noted that the index line on the gage must be on the center of the flange, which can usually be determined by a raised comby line.

Rule 78.—This rule clearly defines the method of measuring broken rims and only ordinary care is necessary to gage this defect properly. However, good judgment should be used in shopping loaded cars for this defect if close to their destination. Under favorable conditions, a cast-iron wheel should wear off 7/16 in. and give well over 100,000 miles of service, but largely due to such defects as slid flat spots and brake burns, the average wear from the tread is only ¼ in., therefore it is of the greatest importance to maintain the brakes in the best possible condition.

Rule 82.—While the use of the remount gages does not concern our car inspectors in their every day duties, it might be of interest to mention them. Remount gages must not be used to condemn a wheel in service, but are for the purpose of determining whether a wheel, the mate for which has been condemned, has sufficient service remaining in it to justify the expense of remounting at the wheel house. These gages are designed to scrap a wheel with such defects as worn flanges and hollow treads, when they reach a point ⅛ in. above the actual condemning limit, shelled-out spots 1-in. in length or width, brake-burned spots having a continuous cavity of 1 in. in length and brake-burn cracks 2 in. in length, also condemns a wheel for remounting. The manner of application of the remount gages is substantially the same as that of the gages used by car inspectors.

* * *



Paraffin base liquid painted over the glass before the exterior of the car is spray painted obviates the use of a masking shield—After painting is complete the masking coat is scraped off the window with a putty knife, to remove paint splashed on the outer surface

IN THE BACK SHOP AND ENGINEHOUSE

Interesting Method for Laying Out Shoes and Wedges

The method of laying out shoes and wedges described herein is that which has been in use for some time at the West Albany shops of the New York Central. The method is based on placing two straight edges parallel to an imaginary horizontal center line between the engine frames. Before proceeding with the actual laying out of the shoes and wedges, the engine-truck center casting and trailer-truck radius-pin center, if any, should be checked to ascertain if they are central between the frames.

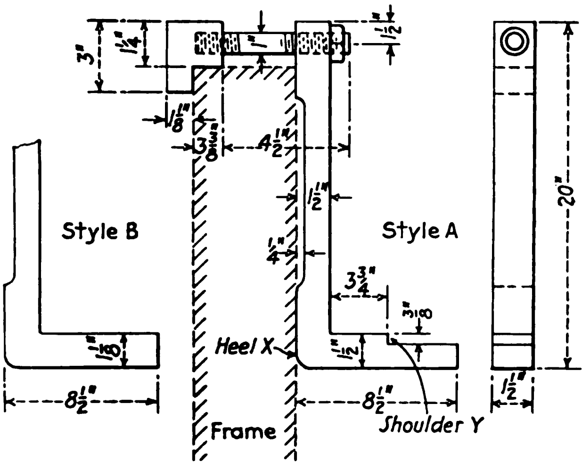


Fig. 1—Straight edge supports

The Style A straight-edge supports, shown in Fig. 1, are suspended from the frame at the front and back pedestal jaws, while the Style B support, which is used to keep the straight edge from sagging, is placed midway between the Style A supports. It is essential that the heel *X* of both Style A and B supports rest against unmarred surfaces of the frame from which all grease has been removed. The straight edges are then placed on the supports in a manner such that they rest firmly against the shoulder *Y* of each Style A support.

With the straight edges in position on the frames, dimensions *A* and *B* shown in Fig. 2 are taken accurately. If these dimensions are equal, the frames are parallel and the machinist can proceed with the layout of the shoes and wedges. If the frames are not parallel, the straight edges must be made parallel to the horizontal center line between the frames shown in Fig. 2.

Layout Example

Referring to Fig. 2, if dimension *A* were 57 in. and dimension *B* $57\frac{1}{8}$ in., a $\frac{1}{16}$-in. shim should be placed between the straight edge and its support at *A* in order to make the straight edges parallel.

The center of any jaw on the right side is then established as illustrated by the location of point *C* in Fig. 3. A parallel plate is then placed across the top of the frame, precaution being taken to keep the plate from rocking, and a try-square is placed on the parallel plate with the edge in line with the established center *C* of the jaw. A T-square is then placed across the straight edges and adjusted so that its blade touches the edge of the try-square located at the center of the jaw.

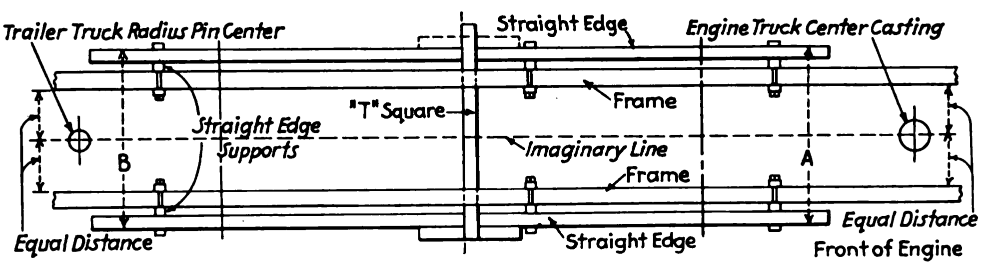
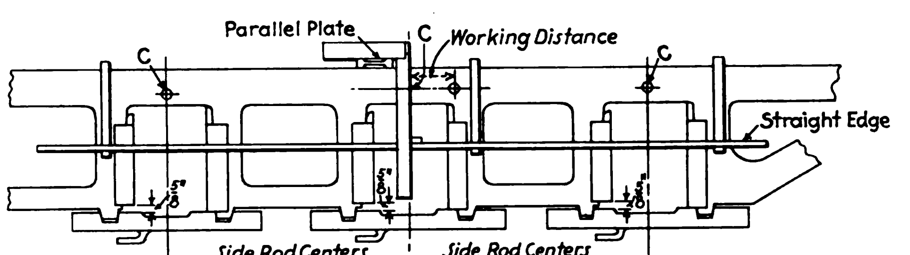


Fig. 2—Straight edges made parallel with a horizontal line between the frames



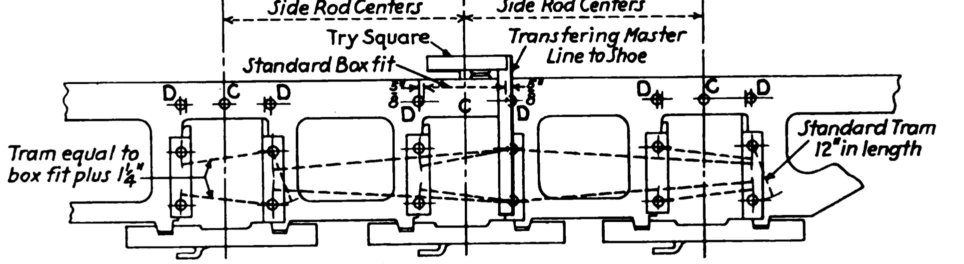


Fig. 3 (above)—Method of establishing center of pedestal jaws; Fig. 4 (below)—Method of laying out width of driving boxes on the frame

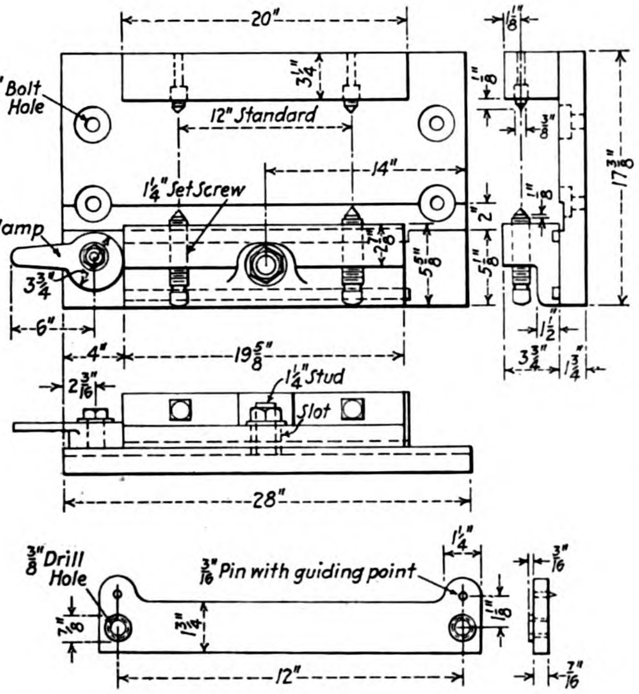


Fig. 5—Chuck that automatically lines up shoes and wedges for machining to layout marks

The try-square is then taken to the left side of the engine and placed on the parallel plate with the edge of the try-square against the edge of the T-square; while performing this operation the T-square must not be moved. A line is then scribed on the frame at the center of the jaws. The T-square is then taken to the left

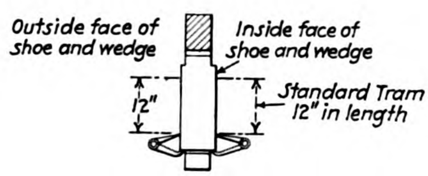


Fig. 6—Locating layout marks on the bottom of shoes and wedges

side of the engine, where it is placed against the edge of the try-square for checking the center of the jaw. If the jaw centers check correctly, centers have been established which are absolutely perpendicular to the center line of the engine, and the machinist can proceed

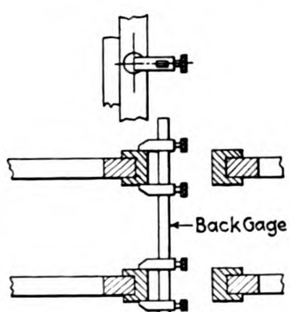


Fig. 7—Transferring layout marks to the inside of shoes and wedges

with the layout of the shoes and wedges. If the jaw centers do not check correctly, either the T-square is not true, or the straight edges are sprung and should be checked.

Having established the center of one jaw *C* as shown in Fig. 2, a beam tram, set to a distance equal to that

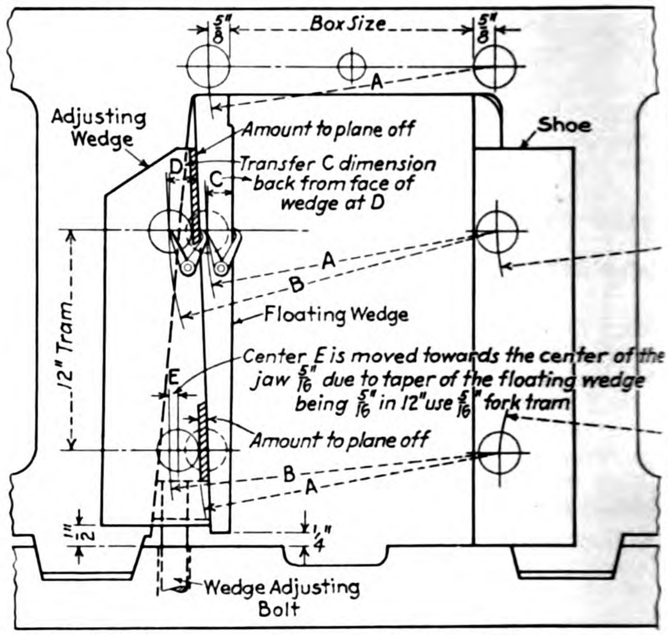


Fig. 8—Method of laying out Franklin automatic adjustable driving box wedge with taper floating-plate

between the wheel centers, is placed in this center and other points, also designated at *C* in Fig. 3, are scribed on the remaining jaws, thus establishing the correct center of each jaw.

After these centers have been located, the shoes and wedges are mounted on the pedestal jaws, using suspenders to hold them firmly against the jaw faces. From the points *C*, half the width of the driving box, plus the dimension of the proof ring tram (in this case $\frac{5}{8}$ in.) is laid off on both sides of the center *C*, thus establishing the points *D* shown in Fig. 4. With the try-square supported on the parallel plate in a position such that the edge of the try-square in line with the points *D*, a line is scribed the full length of each shoe and wedge. The chuck shown in Fig. 5, is then used for planing the shoes and wedges to the layout marks. Where this chuck is used a four-point layout is necessary. Since it is not practical to establish the layout

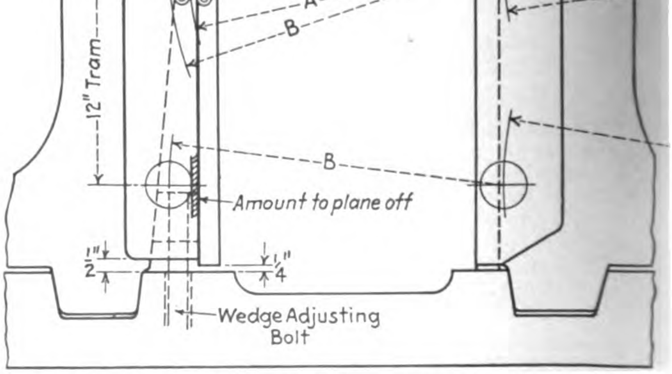


Fig. 9—Layout of Franklin adjustable wedge of the straight floating-plate type

marks absolutely perpendicular across the shoes and wedges a lateral movement of ½ in. is provided in one of the chuck jaws.

The bottom layout marks should be established with a pair of hermaphrodites from the bottom of the shoe and wedge; the upper marks are correctly established with a fixed 12-in. tram. This method is shown in Fig. 6. The shoes and wedges are laid out on the face as described previously, and then the layout marks are transferred to the inside face by means of the back marker shown in Fig. 7.

Figs. 8 and 9 illustrate the methods followed in laying out Franklin automatic adjustable driving-box wedges of the tapered floating-plate type and straight floating-plate type, respectively.

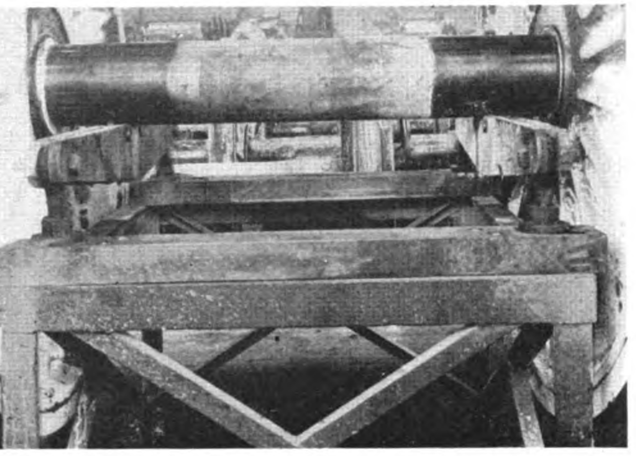
Denver Shop Jigs And Devices

Among numerous special jigs and devices of unusual interest at the Denver, Colo., shops of the Chicago, Burlington & Quincy is a roller-bearing counterbalance stand shown in the illustration. This stand consists of a rigidly braced, welded, steel framework, 50 in. wide by 54 in. long by 36 in. high, constructed primarily of 4-in. by 4-in. by 3-in. and 2-in. by 2-in. angle section joined by electric welding.

The weight of the driving wheel and axle assembly is supported by the journals bearing on two pairs of steel rolls, each pair of rolls operating in the same plane and being suitably mounted in a built-up beam construction which can be readily leveled or adjusted for height by means of four 1-½-in. adjusting units, one at each corner of the counterbalance stand. The supporting rolls for each journal are 5-in. in diameter and set between a pair of 1-in. steel-plate beams 50 in. long by 6 in. wide at the center, tapered to 3½ in. wide at each end.

As compared to the usual parallel straight-edge type of counterbalance stand, this design possesses the important advantage of greater sensitiveness, greater ease of adjustment and increased safety. With accurate, well lubricated rolls and clean journals, the heavy driving wheels will revolve easily and be responsive almost to the finger-touch. By means of the adjusting screws and nuts, the supporting bars may be readily adjusted for equal height and level, and, moreover, it is not necessary to use the same painstaking care in levelling as would be required with a counterbalance stand of the parallel-straight-edge type.

The fact that the driving wheels and axle revolve in one fixed position instead of rolling along a pair of straight edges, may be conceded as a somewhat safer

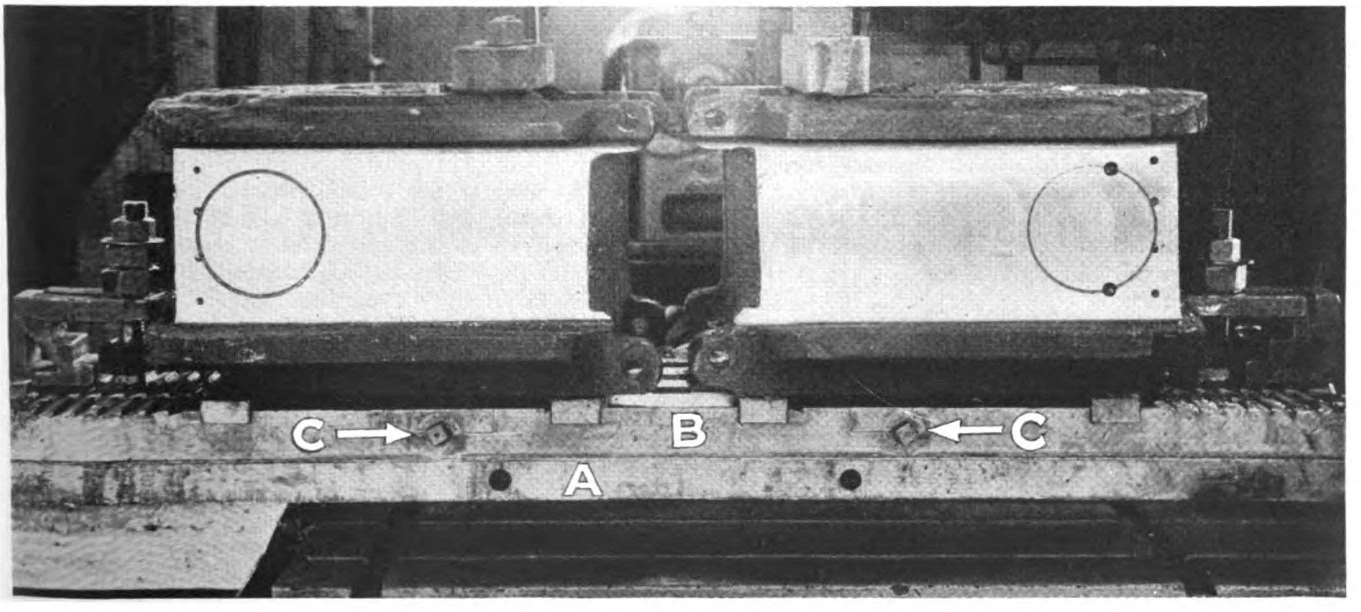


Roller-bearing counterbalance stand used at the Denver shops of the C. B. & Q.

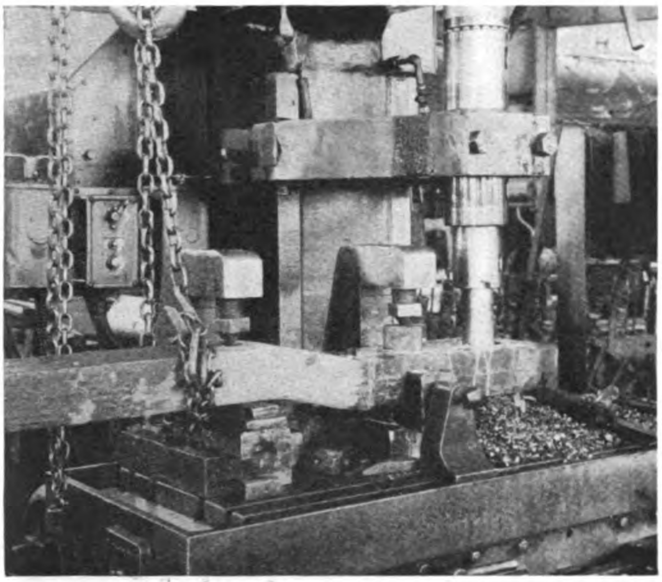
operation, since there is no possibility of the wheels rolling off the end of the stand. A still further advantage of this type of counterbalance stand, due to the fact that each pair of supporting rolls operates in the same plane, is that the bearing rolls occupy only a short length on each journal and may be readily used in the limited space sometimes available when driving journals are designed for the application of roller-bearing boxes.

Milling Driving-Box Shoe-and-Wedge Ways

The large Morton cylinder-boring machine, not being kept busy exclusively on cylinder work, is used to advantage in milling the shoe-and-wedge faces of driving boxes by means of a special chuck shown in one of the



Special jig used in milling driving-box shoe-and-wedge faces on a Morton cylinder-boring machine

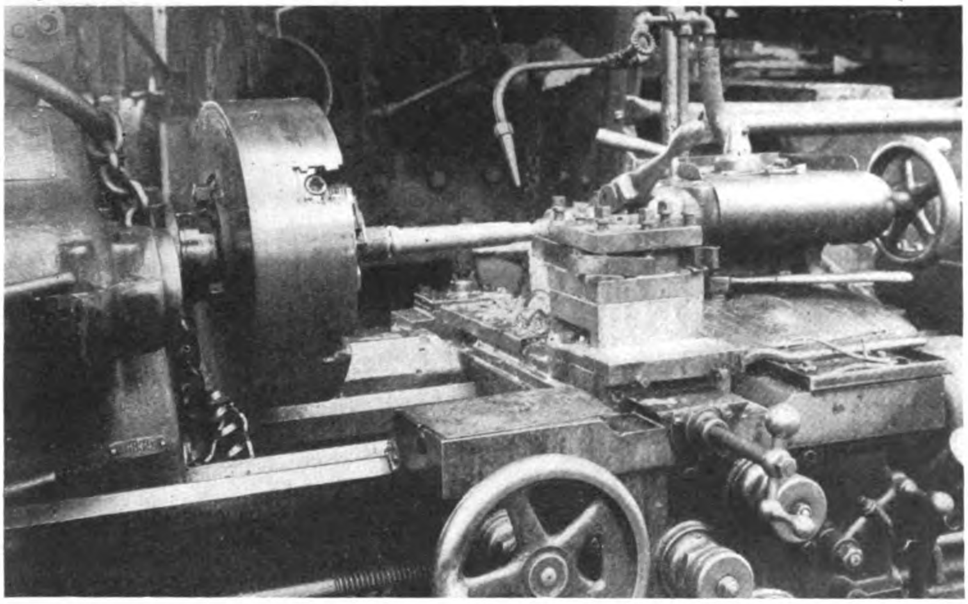


Rigid clamping device and outboard spindle support used in boring drawbar holes on a heavy-duty drill

equipped with two centering chucks operated by the screws (CC). With this equipment, the driving boxes are quickly and accurately lined up and centered on the jig. The clamping arrangement consists of four 1-in. hold-down bolts and nuts, these bolts extending through suitable U-bars one at each end and one across the upper face of each driving box. This method of clamping proves entirely adequate to hold the boxes during the relatively light milling operation which is done with a face milling cutter in the boring-machine spindle.

Drill Set-Ups for Boring Drawbar Holes

The use of a Baker 5-in., heavy-duty drilling machine for refinishing one of the holes in a locomotive drawbar is shown in one of the illustrations. The drawbar, in this instance of the offset type, is securely clamped to the drilling-machine table by means of a pair of exceptionally heavy forged-steel clamps having a 2-in. adjusting nut in the top of each, with taper point which is used to bring pressure either directly against the drawbar or against a pressure block which rests on it. The drawbar is held against side slip by a separate clamp equipped with a pressure-adjusting screw in the upper end and a T-shape projecting rib on the bottom to fit the T-slot of the drilling machine table.



Boye & Emmes 18-in. portable engine lathe equipped for machining and fitting locomotive frame bolts in the erecting shop

illustrations. This chuck is of the self-centering, swivel type so that set-up time is minimized, and, when one side of a pair of boxes has been machined using a face mill in the boring-machine spindle, the chuck can be readily swiveled through 180 deg., index pins inserted to hold it in place, and the other shoe-and-wedge faces machined accurately parallel with the first. It is said that this method of machining gives a better job in approximately one-half the time, as compared with planing.

Referring to the illustration, the construction of the driving-box chuck is clearly shown. The jig consists essentially of two steel plates 60 in. long by 15½ in. wide by 2 in. thick, base plate *A* being provided with a tongue on the longitudinal center line which fits a groove in the Morton boring-machine table. Plate *B* is arranged to swivel on plate *A* about a 1-in. center bolt (not visible in the illustration) which passes through plate *A* to the boring machine table. Two index bolts, provided at opposite corners of the jig, accurately locate plate *B* with respect to plate *A* in either one of two 180-deg. positions.

The pair of driving boxes rest on four steel cross bearing pieces set into the face of the jig which is

To provide ample rigidity and, at the same time, free rotation of the drilling machine spindle, a heavy outboard support is provided, as shown in the illustration. This consists of a substantial forged-steel bracket suitably clamped to the drilling machine column and designed with a well lubricated split bushing and removable steel cap on the outer end to serve as a guide for the spindle. With this construction, fairly heavy cuts may be taken by the cutting tool and irregular holes trued up quickly and accurately on a drilling machine, at less cost than if done on a boring machine.

Making and Fitting Locomotive Frame Bolts

Locomotive frame bolts are manufactured on a Boye & Emmes 18-in. portable engine lathe, located in the erecting shop adjacent to the locomotive for which bolts are being fitted. The material used in making these bolts is a special heat-treated steel and the bolts are made directly from round bar stock, with only a $\frac{3}{16}$-in. shoulder allowed for the head of the bolt. All of the operations, including taper turning, threading

and cutting off are done on this lathe with a minimum of lost motion, unnecessary steps, etc.

Referring to the illustration, it will be observed that the engine-lathe carriage has been provided with a turret head equipped with all of the tools necessary for turning, thread cutting and cutting off. The bar stock is gripped in a four-jaw universal chuck and a special ball-bearing dead center is used to reduce friction and serve as a firm support for the outer end of the bolt. The lathe is equipped with a taper attachment for cutting the bolt taper, and a fluid pump, with suitable pipe connections, gives an adequate flow of coolant so that fast cutting feeds and speeds may be used.

The success of this method of individual bolt fitting hinges very largely on the skill of the machine operator who, after suitable experience, can turn out completely

Unusually convenient machine, operated by one man, for grinding the joints in long dry pipes and exhaust pipes

finished bolts all threaded and ready for application in from 3 to 5 minutes apiece, dependent upon the bolt size. One of the primary advantages of this method is the saving in time formerly required going to and from the machine shop or storehouse to secure engine bolt supplies. Moreover, it avoids the necessity of carrying a large stock of bolts on hand and there is a considerable saving in material as bolts are made with just the right length in the first place, and it is not necessary to cut them off and rethread the ends, as frequently happens when engine bolts are drawn from stock and the exact length needed may not be available.

Still another advantage is that the bolt holes in locomotive frames, guide blocks, cross ties, cylinder saddles, etc., need not be reamed out to some standard size, but are reamed only enough to provide a smooth, true hole to which the bolt is fitted. This avoids the rapid and undue enlargement of bolt holes, with attendant weakening and reduced service life of the associated parts, some of which have definite limits as regards bolt-hole size.

One Man Operates Dry-Pipe Grinding Machine

The dry-pipe grinding machine, shown in the illustration, is interesting not only because it was designed and built at the Denver, Colo., shops of the C.B.&Q., but because it represents an unusually compact and efficient design which can be readily operated by one man.

The machine is built on a heavy cast-iron base plate 6 ft. long by 40 in. wide, monuted on short legs and supporting, at the nearest corner, a standpipe column *C* 9 in. in diameter by 66 in. high, equipped with a 42-in. by 19-in. by ¾-in. steel footplate on top on which a man can stand while adjusting the various lever arms and fulcrum pin position required, dependent upon the length of the dry-pipe being ground. The double-bar vertical arm *D,* made of two pieces of 4-in. by ¾-in. steel, 5 ft. 2 in. long, extends directly above the standpipe column and serves as a fulcrum for a 5-ft. cross lever *E,* connected at the short end by means of chain falls to the dry-pipe and at the other end to long double-bar arm *F.* The lower end of arm *F* is equipped with a yoke for connection to air cylinder *G* which is firmly bolted to a bracket on the standpipe column. Admission of air to the cylinder by means of a small air valve forces the piston down and raises the dry-pipe three or four inches whenever it is necessary to apply new oil or abrasive to the joint which is being ground, or to make a visual inspection of the progress of the work.

The base of the machine is equipped with the operating table *L* of a link grinder. This table is given a partial rotary and reverse motion by means of suitable lever connections and gear-reduction drive from an air motor *M.* The dry-pipe itself is held against turning by means of handle *H* on a special clamp, and the nigger head, ball joint, or whatever casting forms the lower part of the joint, is bolted to T-slots in table *L* and given a partial rotary and reverse motion whenever the machine is in operation.

The table speed may be varied to suit the size of the joint being ground, but is usually adjusted to about 40 reversals per minute.

In the illustration, the exhaust pipe *P* of an articulated locomotive is being ground to a seat on one of the large ball joints required to make a flexible connection. This heavy pipe may be readily raised whenever necessary for redistributing the oil and abrasive, or for inspection, by simply opening a small valve which admits air to the cylinder. This is a three-way valve which, when closed, exhausts air from the cylinder and lowers the pipe *E* back on the ball seat. The feature of this machine is that mechanical labor in grinding dry-pipe joints is eliminated and one man can do the job, whereas two or more were formerly required.

Addition to Murex Coated Electrodes

The Metal & Thermit Corporation, New York, announces an addition to its line of Murex heavy coated electrodes for arc welding. The electrode, known as Murex type N, is designed for bridging gaps where the fit between plates is poor and, in the smaller sizes, may

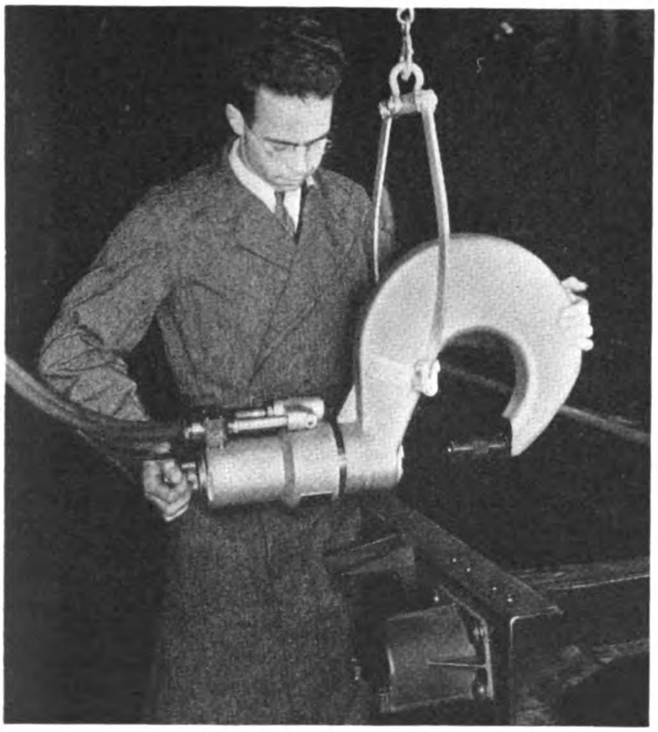
be used on vertical and overhead work, or to make rapid, single pass welds on light gage materials. In addition, it can be used to produce single or multiple pass fillets.

The physical properties of the metal deposited by the Murex type N electrode are said to range from 74,000 to 84,000 lb. per. sq. in. in tensile strength with 26 to 24 per cent ductility. The electrode is also said to work equally well with either direct or alternating current and may be used either with straight or reversed polarity.

Electric-Hydraulic Riveter

An electric-hydraulic riveter has recently been added to its line by the Hanna Engineering Works, Chicago, Ill. The power unit of the riveter is a combination of a motor-driven primary pump, a valve mechanism and an intensifier. The fluid pressure developed is transmitted to the riveter by flexibile high-pressure hose. It provides a rapid advance of the ram to the rivet, and the rapid return of the ram to its normal position.

The operator controls the riveting cycle by depressing a pilot or trigger switch which operates a solenoid-actuated valve permitting the fluid under primary pressure to flow directly to the riveter cylinder. At the instant the riveter ram or plunger has preformed the rivet to whatever is within the capacity of the primary pressure, the intensifier acts automatically to boost the pressure to that which will finish the rivet. When the maximum pressure has been exerted upon the rivet, the primary control valve is automatically reversed, and the ram returns to the starting position whereupon the primary control valve automatically shifts to its neutral position.



Portable 20-ton electric-hydraulic riveter

The release of the pilot switch will reverse the ram movement whether it be in the primary or high-pressure stage of the riveting cycle. Likewise, depressing the pilot switch will change the return ram movement to a forward or driving stroke. As long as the operator depresses the pilot switch the riveter will complete a cycle and only one. He must release the switch and depress it again to start another cycle. Thus, a repeat cycle cannot take place.

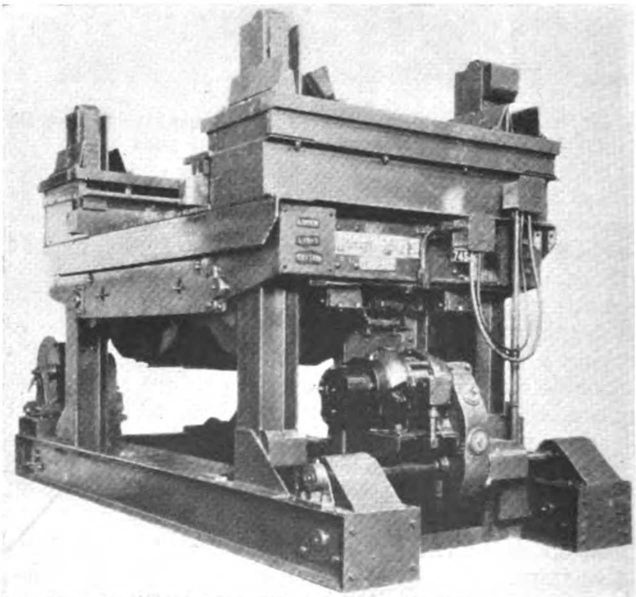
To protect the operator, a low-voltage transformer is built into the power unit for the pilot-switch circuit. Thermal-overload relays protect the motor. The unit illustrated exerts 20 tons on the dies and is capable of driving ⅜-in. rivets cold, forming a full button head. Portable and stationary units for driving rivets up to 1⅛ in. hot are also available.

All-welded Drop Pit Table

The Shaw Box Crane & Hoist Company, Inc., Division of Manning, Maxwell & Moore, Inc., Muskegon, Mich., has developed a drop-pit table of all-welded construction for use at division-point back shops and roundhouses. This unit is constructed entirely by arc welding and is made in both movable and stationary types for removing and replacing locomotive driving-wheel sets and engine and trailer trucks, as well as for use in car shops.

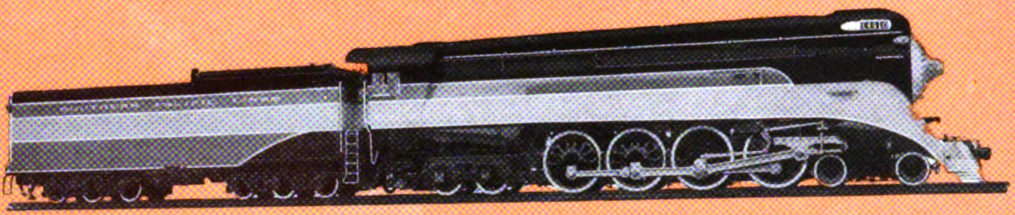
Three independent units make up the complete table—the truck, lifting table and table top. The lifting table, operated by push-button control, is raised and lowered between rigid steel columns, mounted on the truck, by four drums and four flat steel flexible cables. The drums are operated simultaneously by one motor through two duplicate gear drives contained in the table. Hence, an equal pull is applied at each corner of the table. The columns support and guide the table. The table top is detachable and is equipped with locking bars and sections of rails to form a continuous track over the pit when locked in position.

The feature of the design of this drop-pit table is the use of the four flexible cables and winding drums for raising the load, rather than the former practice of using jack screws. This permits the raising or lowering of the load without spotting accurately on the table top. The



The Shaw arc-welded drop-pit table

THE LARGEST STREAMLINED LOCOMOTIVES *in* *The World*



SOUTHERN PACIFIC 4-8-4

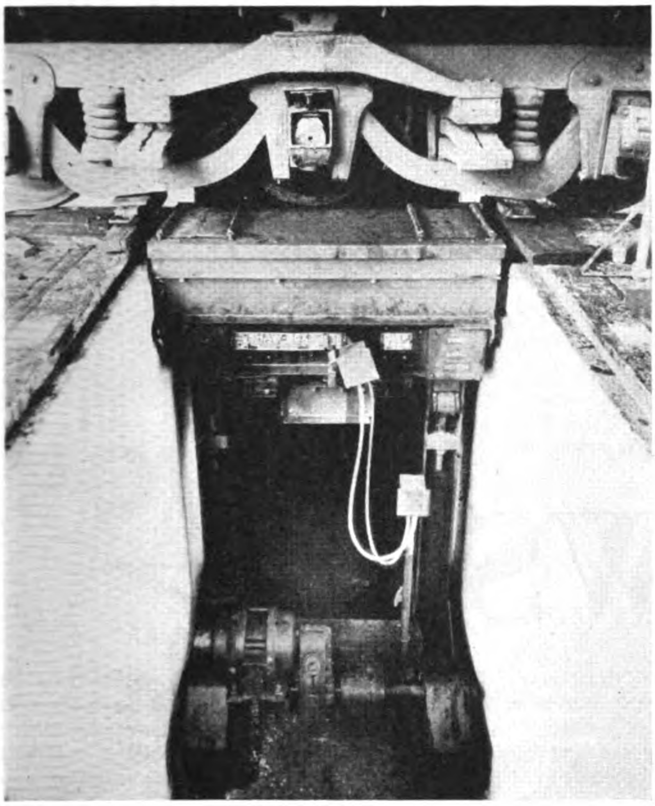
WEIGHT IN WORKING ORDER, POUNDS				
On Drivers	Engine Truck	Trailer Truck	Total Engine	Tender Loaded
266,500	77,400	Front 46,300 Rear 58,200	448,400	372,880

WHEELBASE				TRACTIVE EFFORT	
Driving	Engine	Eng. & Tender	Length Over All	Main Cylinders	With Booster
20′ 0″	45′ 10″	94′ ½″	109′ 6″	62,200	74,710

BOILER		CYLINDERS		DRIVING WHEEL
Diameter	Pressure	Diameter	Stroke	Diameter
Front 86″ O. D. Rear 96″ O. D.	250 lb.	27″	30″	73½″

LIMA LOCOMOTIVE WORKS, INCORPORATED

LIMA, OHIO



The Shaw arc-welded drop-pit table installed at the Cincinnati Union Terminal, Cincinnati, Ohio

table is moved along its track on four wheels driven by gearing connected with an electric motor mounted on the base of the unit.

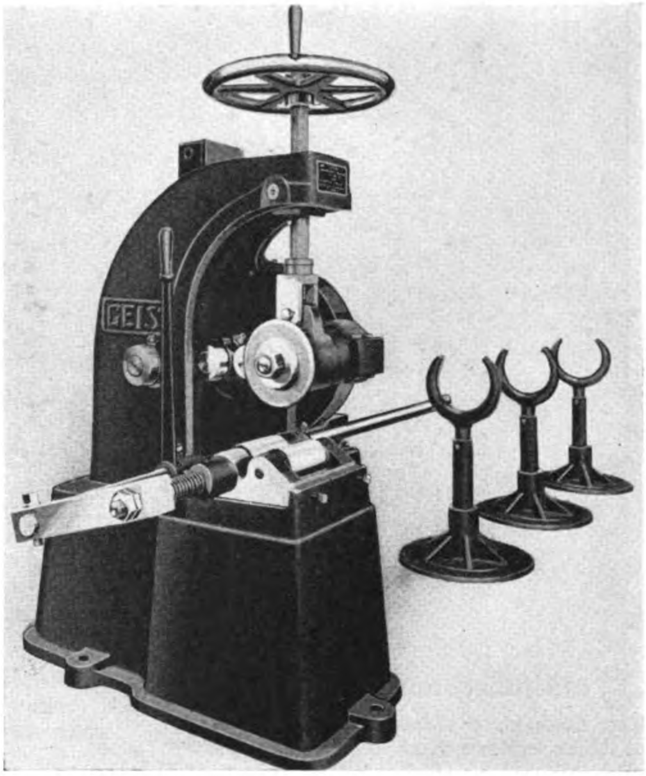
The unit is supported by four standard H-columns carried on and welded to a base composed of two H-columns welded integral with cross connecting members. Additional stiffness is provided the vertical columns by steel gusset plates welded to them and to the base. The lifting table is also fabricated by welding a number of separate parts, including channels, H-columns, plate, and angles, into a single piece of steel. Arc welding is reported to save approximately 15 per cent in weight.

Operating advantages claimed for the arc-welded drop-pit table are as follows: It will not bind or stick when loading is unbalanced because it is designed for unbalanced loading and there is an equal pull at each corner of the table. The water nuisance sometimes prevalent in pits is eliminated because there are no guides to destroy water proofing in pit walls. Maintenance costs are low because all gearing operates in baths of oil in sealed enclosures. It is safe because it cannot be lowered except by power, and the table stops instantly when power is shut off. The table is stopped by an automatic stop when it reaches its highest or lowest position.

Improved Geist Roller Pipe Cutter

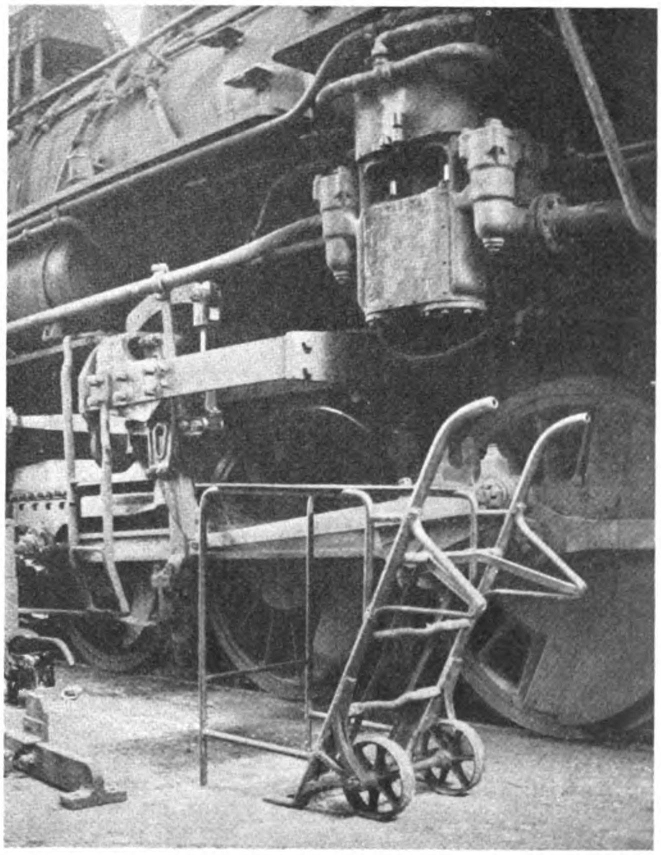
An improvement has been made recently on the No. 4 Geist roller pipe cutter which is marketed by the Landis Machine Company, Waynesboro, Pa. The shaft which carries the disc cutter is now being mounted in Timken roller bearings instead of bronze bushed bearings as heretofore used.

This improvement has been incorporated in the cutter to give it added rigidity and to insure precise alignment between the cutter shaft and the rollers, thus minimizing the cutting time, reducing the burr thrown up on the pipe and increasing the life of the disc cutter. The machine can be used for cutting ½-in. to 4-in. pipes, inclusive.

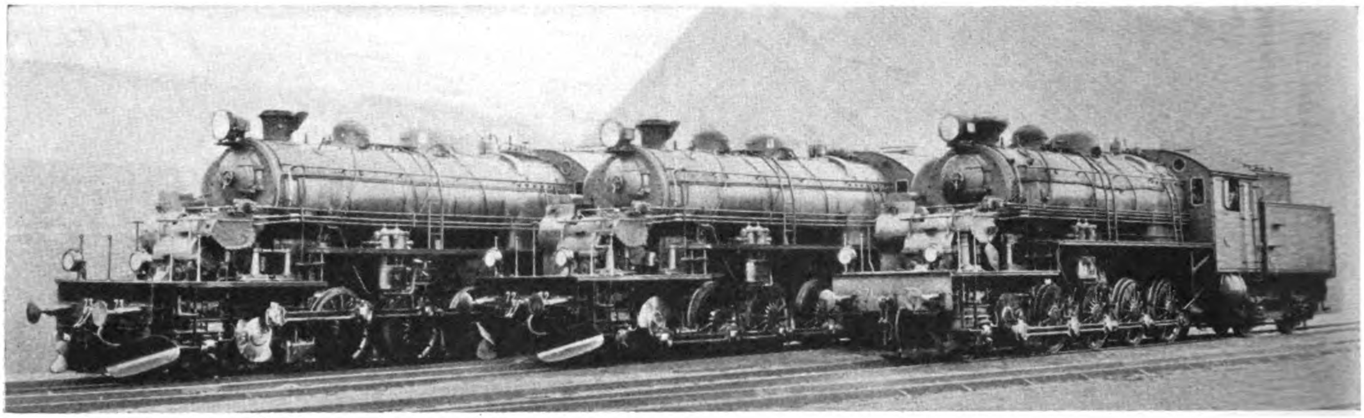


The Geist pipe cutter with the disc mounted in Timken roller bearings

* * *



Convenient, safe and portable steel platform



Non-condensing steam turbine locomotives on the Grangesberg-Oxelosund Railways in Sweden

NEWS

Machinery and Tools

THE *Louisville & Nashville* has authorized the expenditure of about $500,000 for new shop machinery during 1937.

The New York, New Haven & Hartford has ordered a 90-in. driving wheel lathe from William Sellers & Co., Inc.

The Western Pacific has ordered one 200-ton wrecking crane and several special shop tools from the Industrial Brownhoist Company.

The Swedish Turbine Locomotives

THE photograph reproduced on this page shows three Ljungstrom non-condensing steam turbine locomotives on the Grangesberg-Oxelosund Railways in Sweden. The locomotive in the foreground has been in service since 1932 and the two back of it have been placed in service more recently. The older locomotive has made about 135,000 miles in slow-speed heavy freight service, running about 71,500 miles between general repairs, which is said to compare with 31,000 to 36,000 miles for the reciprocating locomotives on this railroad. Comparative tests between older turbine and reciprocating locomotives which were run in July, 1933, are said to have shown a fuel saving of 23.8 per cent for the turbine locomotive, and the low fuel consumption of the turbine locomotive is said to be still maintained. The locomotive has an adhesive weight of 72 tons and is in service hauling iron-ore trains of 750 tons on 1 per cent ruling grades.

More Attention to Maintenance of Draft Gears

IN Circular DV-889 recently issued Secretary Hawthorne of the Mechanical Division, Association of American Railroads, calls attention to the fact that on June 9, 1936, W. J. Patterson, director, Bureau of Safety, Interstate Commerce Commission, advised that from the investigations of accidents attributable to draft-gear failures it is evident that the recommended practice rules covering inspection and maintenance of draft gears and attachments by car owners adopted by letter ballot in 1934 are not being complied with by some carriers and private-car lines. The circular urges the member roads and private-car owners to establish a program of draft-gear maintenance conforming to the A.A.R. recommended practice and requests that each railroad and car owner submit to the secretary of the Mechanical Division a copy of such instructions as may now be issued to carry out the recommended practice of the association.

Observance of Loading Rules

MECHANICAL Division Circular D. V.—890, recently issued by the secretary, reads as follows:

Complaints are being received that some railroads are accepting open top cars on which loads are not secured in accordance with the Rules Governing the Loading of Commodities on Open Top Cars. Some of these complaints have been investigated by the Mechanical Inspection Department and found to be justified.

Interchange Rule 2 provides that loaded cars must be accepted with certain exceptions, one of which is—

"(c) Cars improperly loaded (not conforming with the Rules Governing the Loading of Commodities on Open Top Cars) when transfer or rearrangement of lading is necessary, even though the load may have originally conformed to such rules."

This rule provides for the rejection of improperly loaded cars at interchange but, since it and the loading rules to which it refers, were promulgated in the interest of safety and contain the minimum requirements for the safe transportation of commodities involved, it is important that full and complete observance be insisted upon whether it be in connection with loads offered in interchange or those offered for exclusive movement over the rails of an individual carrier.

It is urged that proper instructions be issued to all concerned that no loads will be accepted or offered for movement which do not comply with the Rules Governing the Loading of Commodities on Open Top Cars.

Equipment Building and Betterment Programs

THE *Southern Pacific* has announced plans for the construction and rebuilding of passenger, freight and motive power equipment to cost more than $16,500,000, bringing the company's total appropriation for new and modernized cars and locomotives during the last 12 months to over $41,000,000. The latest appropriation provides for the expenditure of nearly $15,000,000 for new rolling stock and motive power and includes the following items: 28 new steam locomotives—14 to be streamlined and designed for passenger service; 2,725 new freight cars, including 1,175 automobile cars; 41 new passenger cars—all of modern light-weight type. Air-conditioning and modernization of passenger-train equipment will cost $1,200,000. Details of orders for some of this equipment are reported elsewhere in these columns.

The St. Louis Southwestern has been authorized by the federal court to spend $1,825,715 for the building of 5 locomotives, the purchase of 10 air-conditioned passenger coaches and for general additions and betterments.

The Great Northern has adopted a program of rehabilitation calling for the expenditure of $33,000,000, the completion of the program depending upon a continued rise in the company's revenues. Of the total, $22,000,000 will be spent for regular maintenance work; $6,500,000 for 500 new ore cars, 500 gondola cars and 1,000 box cars (reported elsewhere in these columns); $2,750,000 for rebuilding 11,000 freight cars in company shops, and the purchase of 12 coaches; and $1,750,000 for rails and fastenings.

(*Continued on second left-hand page*)

New Equipment—Orders and Inquiries Announced Since the Closing of the December Issue

Locomotive Orders

Road	No. of locos.	Type of loco.	Builder
A. T. & S. F.	11 [1]	4-8-4 Pass.	Baldwin Locomotive Works
	6 [1]	4-6-6-4 Pass.	
	10	2-10-4 Frt.	
B. & L. E.	10	2-10-4	American Locomotive Co.
	2	0-8-0	
C. B. & Q.	10 [2]	4-8-4	Company shops
D. & R. G. W.	10	4-6-6-4	Baldwin Locomotive Works
	5	4-8-4	
D. L. & W.	5 [3]	4-6-4	American Locomotive Co.
S. A. L.	5	2-6-6-4	Baldwin Locomotive Works
Sou. Pac.	10	Tenders	Lima Locomotive Works
	14	4-8-8-2 Frt.	
	14	4-8-4 streamline	
Union R. R.	4	0-10-2	Baldwin Locomotive Works
Western Pac.	7	4-6-6-4	American Locomotive Co.
	4	2-8-8-2	Baldwin Locomotive Works
W. & L. E.	10 [4]	2-8-4	American Locomotive Co.
Weyerhaeuser Timber Co.	2	2-6-6-2	Baldwin Locomotive Works

Freight-Car Orders

Road	No. of cars	Type of car	Builder
A. T. & S. F.	1,500	50-ton box	Pullman-Standard Car Mfg. Co.
	500	50-ton box	American Car & Fdry. Co.
	200	50-ton refrig.	General American Trans. Corp.
	500	40-ton refrig.	
	325	70-ton gondola	
C. & N. W.	500	70-ton auto	Pressed Steel Car Co.
	500	50-ton auto	Mt. Vernon Car Mfg. Co.
C. & O.	500	Gondolas	American Car & Fdry. Co.
	500	Hopper	
	500	Box	General American Trans. Corp.
	500	Hopper	Pullman-Standard Car Mfg. Co.
	50	Caboose	Magor Car Corp.
	25	70-ton dry bulk	American Car & Fdry. Co.
	50	40-ton stock	Greenville Steel Car Co.
C. B. & Q.	1,000 [2]	50-ton steel frame box	Company shops
	250 [2]	Steel frame auto.	
	250 [2]	All-steel hopper	
	1,500 [2]	Gondolas	
	100 [2]	Flat	
	150 [2]	Steel frame stock	
	300 [2]	Refrig.	Refrigerator Express Co. [3]
D. & H.	60	55-ton hopper	Company shops
	100	40-ton box	
D. & R. G. W.	100 [5]	70-ton Hart selective ballast	American Car & Fdry. Co.
Dominion Steel & Coal Corp., Ltd.	100	Hopper	Eastern Car Co.
D. M. & N.	50	Hopper	Ryan Car Co.
E. J. & E.	200	50-ton hopper	Mt. Vernon Car Mfg. Co.
	750	50-ton gondolas	
	100	65 ft., 70-ton gondolas	
Gen. Chemical Co.	97	50-ton tank	General American Trans. Corp.
	28	70-ton tank	
	15	40-ton tank	
Godfrey L. Cabot, Inc.	10	35-ton special hoppers	Pressed Steel Car Co.
Grt. Nor.	500	Ore	Bethlehem Steel Co.
Montour R. R.	500	Hopper	Pullman-Standard Car Mfg. Co.
N. & W.	1,000	55-ton hopper coal	Bethlehem Steel Co.
N. Y. C. & St. L.	500	50-ton gondolas	American Car & Fdry. Co.
	25	70-ton dry bulk	
	500	50-ton box	General American Trans. Corp.
	100	50-ton auto-box	Ralston Steel Car Co.
	75	50-ton hopper	Pullman-Standard Car Mfg. Co.
N. Y., N. H. & H.	150	Low-side coal	Company shops
	75	Flat	
Pacific Fruit Express	500 [6]	Refrig.	General American Trans. Corp
	500 [6]	Refrig.	American Car & Fdry. Co.
	500 [6]	Refrig.	Pullman-Standard Car Mfg. Co.
	500 [6]	Refrig.	Pacific Car & Fdry. Co.
Pere Marquette	25	Caboose	Magor Car Corp.
Reading	25	All-steel Caboose	Company shops
Seaboard Air Line	1,000	Box	Pullman-Standard Car Mfg. Co.
Sou. Pac.	250	Box	American Car & Fdry. Co.
	250	Box	Pullman-Standard Car Mfg. Co.

Freight-Car Orders—Continued

Road	No. of cars	Type of car	Builder
Southern Pacific (Continued)	250	Box	Pressed Steel Car Co.
	250	Box	Bethlehem Steel Co.
	825	Auto-box	General American Trans. Corp.
	350	Auto-box	Mt. Vernon Car Mfg. Co.
Virginian	25	50-ton auto-box	Greenville Steel Car Co.
Virginian Smelting Co.	1	40-ton tank	General American Trans. Corp.
Western Maryland	100 [7]	50-ton auto-box	Bethlehem Steel Co.
Western Pacific	50	50-ton flat	Pacific Car & Fdry. Co.
	100	50-ton Hart selective ballast	American Car & Fdry Co.
	200	Box	Mt. Vernon Car Mfg. Co.
W. & L. E.	250	60-ton hopper	Company shops

Freight-Car Inquiries

Road	No. of cars	Type of car	Builder
B. & O.	1,500	Gondola	....
C. & I. M.	100	50-ton hopper	....
	100	70-ton gondolas	....
Clinchfield	800	Hopper	....
	200	50-ton gondolas	....
	250	50-ton box	....
Grt. Nor.	1,000	50-ton box	....
	500	50-ton gondolas	....
Ill. Central	1,000	40-ft. 6-in. box	....
	800	50-ft. 6-in. box	....
	1,000	50-ton hopper	....
	300	40-ft., 40-ton refrig.	....
Lake Superior & Ishpenning	100-200	50-ton ore	....
L. & N.	3,000	Hopper	....
M-K-T	500	40-ton gondolas	....
	100	40-ton auto, with loaders	....
	150	50-ton auto.	....
	500	40-ton stock	....

Passenger-Car Orders

Road	No. of cars	Type of car	Builder
B. & M.	20	Coaches	Pullman-Standard Car Mfg. Co.
C. & N. W.	23	Challenger-type coaches	Pullman-Standard Car Mfg. Co.
C. & O.	10	Horse-exp.	St. Louis Car Co.
G. M. & N.	1 [8]	Power-mail bagg.	American Car & Fdry. Co.
	2 [8]	Trailer coaches	
Pere Marquette	10	Bagg.-exp.	St. Louis Car Co.
R. F. & P.	6	Bagg.-express	American Car & Fdry. Co.
Sou. Pac.; C. & N. W.; Union Pac.	2 trains [9]	....	Pullman-Standard Car Mfg. Co.

Passenger-Car Inquiries

Road	No. of cars	Type of car	Builder
Grt. Nor.	12	Coaches	....
M-K-T	3	Diners	....
	25	Air-conditioned chair	....
	1	Lounge	....

[1] The 4-8-4 type locomotives will have 80-in. driving wheels, and the 4-6-6-4 type 84-in. driving wheels. Both types will have boilers of nickel steel construction, will be equipped with roller bearings and will burn oil. With these locomotives only one change of engine will be necessary between Chicago and the Pacific coast, the change being made at La Junta, 991 miles from Chicago and 1,236 miles from Los Angeles. The 10 freight locomotives are designed after experimental locomotives which the Santa Fe has used during the past six years in handling heavier trains over mountain territory at higher speeds.

[2] The Chicago, Burlington & Quincy, on December 23, applied to the Interstate Commerce Commission for authority to issue $7,080,000 of two per cent equipment trust certificates, to be sold in connection with the construction of this equipment at a total estimated cost of $8,861,300. The Refrigerator Express Company is a Burlington subsidiary.

[3] With 80-in. driving wheels.

[4] These locomotives will have 25-in. by 34-in. cylinders and a total weight in working order of 431,000 lb.

[5] Ordered for the road by the Rodger Ballast Car Co.

[6] The 2,000 cars will cost approximately $7,785,000. The work of rebuilding 1,750 refrigerator cars will be done in the company's shops at Roseville, Calif., and Los Angeles, at a cost of $2,715,000. The order for 2,000 new cars follows that placed last April for 2,700 cars.

[7] In addition to the 600 cars reported in the December issue.

[8] To be of light-weight streamline design.

[9] See "Equipment Building and Betterment Programs," page 46.

The St. Louis-San Francisco has applied to the United States district court at St. Louis, Mo., for permission to spend $2,-184,875 for the widening of cuts and fills, the replacement of old rails, the construction of bridges, the repair of station buildings and the repairing of locomotives. It also seeks permission to scrap 25 locomotives and 695 passenger and freight cars.

The Missouri Pacific on December 28 was granted permission by the Federal District Court at St. Louis to spend $8,-552,302 for additions and betterments.

Included will be: $114,000 for an engine house at Atchison, Kan.; $125,870 for a 12-stall extension to the enginehouse at Kansas City, Mo.; $67,500 for a 9-stall extension to the roundhouse at Omaha, Neb.; $103,800 for improvements to the power plant at the shops at North Little Rock, Ark.; $2,671,470 for rails, fastenings and labor; $611,000 for automatic block signals, and the balance for equipment, air conditioning, modernizing cars and miscellaneous expense incident to operation of the property.

The Chicago & North Western on December 29, was authorized by the federal district court at Chicago to purchase $6,-307,500 of new equipment as follows: $1,000,000 for eight streamlined passenger locomotives with 84-in. driving wheels, two for use on the "Four Hundred" and six for use on through trains between Chicago and Omaha; $1,385,000 for 23 "Challenger"-type coaches of which 10 will be used on the Chicago-Los Angeles "Challenger" and 13 on two new "Challengers" which will be placed in service between Chicago and San Francisco, and Chicago and Portland about June 1; $1,540,000 for 500 seventy-ton hopper cars; $2,000,000 for 500 fifty-ton automobile cars; and $382,-500 for 150 seventy-ton ballast cars.

The Norfolk & Western will buy 1,000 hopper coal cars and 40,000 tons of 131-lb. rail and fastenings. The coal cars are in addition to the 500 gondolas and 500 hopper coal cars to be built in the company's shops at Roanoke, Va., as reported in the December issue. The total cost of this equipment and rail, including the eight 2-6-6-4 locomotives reported also in December will be about $8,000,000.

The Western Pacific has awarded a contract to Ryberg Brothers, Salt Lake City, Utah, for work in connection with the extension of its enginehouse at Oroville, Cal., at a cost of approximately $51,000. The work to be done under this contract involves the construction of six additional stalls in the enginehouse, which now embodies eight stalls, to accommodate locomotives having an overall length of 118 ft. the new stalls will be 140 ft. in length, or 40 ft. longer than the existing stalls. Equipment to be installed in the enginehouse addition includes a Whiting drop table and swing gates, a truck drop pit and a 100-ft. monorail hoist.

The Southern Pacific, the *Chicago & North Western* and the *Union Pacific* have placed an order with the Pullman-Standard Car Manufacturing Company for two lightweight, streamline trains. These trains, the largest built thus far, for service between Chicago and San Francisco and Los Angeles, will replace the present City of Los Angeles and City of San Francisco, which will be transferred to other service. The Diesel-electric locomotives, of 5,400 hp. capacity each, will be built by the Electro-Motive Corporation. Each train will consist of 14 cars, with a total length, including the locomotive, of 1,250 ft. The three-unit locomotive will be 208 ft. 8 in. in length, and each unit will have two 900-hp. Diesel-electric power plants. The first car will house the auxiliary Diesel-generator sets used for air conditioning and train lighting. In the Pullman equipment there will be a duplex bedroom car on each train, while other Pullman accommodations will include sections, compartments, drawing rooms and individual and double bedrooms. The berths on all cars will be wider and longer than those on conventional equipment. Each train will have two dining cars; one on each train will be of the coffee shop type for service of popular priced meals. The total capacity of the City of San Francisco will be 228, with 174 Pullman passengers and 54 coach passengers. The City of Los Angeles will have Pullman accommodations for 150 passengers and 104 coach passengers, a total of 254.

Supply Trade Notes

J. E. Mahoney, representative of the P. & M. Company, Chicago, has been promoted to Chicago district sales agent.

Walter D. Snyder has been appointed eastern sales representative of the Ajax Manufacturing Company, Cleveland, Ohio.

Albert E. Hill, service engineer of Standard Equipments, Inc., with headquarters in New York, has been appointed western manager in charge of sales and engineering, with headquarters at Chicago.

The Corbett Corporation, Sawyer and Winter streets, Houston, Texas, has been appointed Texas sales representatives for the Globe Steel Tubes Company, 3839 W. Burnham street, Milwaukee, Wis.

N. M. Lower, who has been associated for several years with the Standard Stoker Company, Inc., at its New York office, has been appointed works manager of the company, with headquarters at Erie, Pa.

The Edward G. Budd Manufacturing Company, railway division, has opened a mid-western sales and service office in the Railway Exchange building, Chicago. Thomas H. Henkle, western sales manager, is in charge of the office.

C. E. Murphy, 415 Midland building, Cleveland, Ohio, has been appointed representative in that region of the Graham-White Sander Corporation, Roanoke, Va., and W. P. Thomas, 4155 Garfield avenue, Minneapolis, Minn., has been appointed representative for the Minneapolis and St. Paul region. Mr. Thomas was formerly road foreman of engines on the Minneapolis & St. Louis and was service engineer of the Franklin Railway Supply Company.

George B. Christian, formerly sales engineer, western territory, for the Wine Railway Appliance Company, Toledo, Ohio, has been appointed assistant general sales manager, and Cleon M. Hannaford has been appointed sales engineer, western territory, both with headquarters at Toledo.

Herman H. Lind has been appointed executive vice-president of the American Institute of Bolt, Nut and Rivet Manufacturers, with headquarters in the Guardian building, Cleveland, Ohio. For 17 years Mr. Lind was engaged in accounting, engineering, production and sales work in the manufacturing field. From 1923 to 1930 he was active in consulting and negotiating work for various manufacturers. In the latter year he became general manager of the Malleable Iron Research Institute, and from July, 1932, through 1936 was general manager of the National Machine Tool Builders' Association.


Herman H. Lind

The American Rolling Mill Company, Middletown, Ohio, has started work on a new modern research laboratory at Middletown, to cost $260,000. The Austin Company are the contractors. The laboratory will replace the building destroyed by an explosion in December, 1935.

Thomas H. Wilber has been appointed general manager of the Bullard-Dunn Process Division of the Bullard Company, Bridgeport, Conn. This division engineers and licenses the use of the Bullard-Dunn electro-chemical process for the descaling of metals. Thomas E. Dunn, Jr., has also been appointed to the sales department of the division. His headquarters will be at 309 Miller-Storm building, 12015 Linwood avenue, Detroit, Mich.

B. C. Wilkerson has been appointed chief eastern service engineer of the Superheater Company, 60 East Forty-Second street, New York, and Frank W. Smith has been appointed service engineer, servicing Elesco equipment on New England railroads. The headquarters of both men will be at New York. Mr. Wilkerson until recently serviced Elesco equipment in the New England territory. Mr. Smith

(Continued on next left-hand page)

started his career as an engineering apprentice in the employ of the American Locomotive Company at Schenectady, N. Y. He then had four years of practical railroad experience with the Union Pacific at Omaha, Neb. With the exception of two years in the U. S. Army Engineers during the World War, Mr. Smith has since been in the engineering department of the Superheater Company.

Tell Berna has been appointed general manager of the National Machine Tool Builders' Association, 10525 Carnegie avenue, Cleveland, Ohio, succeeding Herman H. Lind who is now executive vice-president of the American Institute of Bolt, Nut and Rivet Manufacturers. Mr. Berna is a graduate of Cornell University, where he received the degree of mechanical engineer. For the past six years he has

Tell Berna

been general sales manager of the National Acme Company of Cleveland. Prior thereto he was successively sales manager of the Union Twist Drill Company, Athol, Mass.; the G. A. Gray Company, Cincinnati, Ohio, and manager of the Cincinnati, Ohio, office of Cutler-Hammer.

George W. Bender has been appointed sales representative of the Equipment Specialties Division of the Union Asbestos & Rubber Company, Chicago, with headquarters at St. Paul, Minn., and the Howat Equipment Company, Grant building, Pittsburgh, Pa., has been appointed sales representative in Pittsburgh and other eastern territory.

M. C. Blest, chief engineer of the Pressed Steel Car Company, Inc., Pittsburgh, Pa., has been appointed consulting engineer, and J. P. Anderson, assistant chief engineer, succeeds Mr. Blest as chief engineer. Mr. Blest has been associated with the Pressed Steel Car Company since 1901, prior to which time he spent 12 years with the Harlan & Hollingsworth Company of Wilmington, Del. (now part of the Bethlehem Steel Company), where he served in various capacities in the passenger car and ship building departments. He first served with the Pressed Steel Car Company as draftsman, in 1901, and subsequently as chief draftsman and in June, 1912, was appointed mechanical engineer of the Western Steel Car & Foundry Company (subsidiary of the Pressed Steel Car Company), at Hegewisch, Ill. He went to McKees Rocks plant of the Pressed Steel Car Company in 1915 as mechanical engineer and since 1923 has served as chief engineer.

J. P. Anderson entered the employ of the Pressed Steel Car Company as a draftsman in May, 1904, and subsequently served as assistant chief draftsman and chief draftsman until October, 1919. He was then transferred to Buenos Aires, South America, as sales engineer, returning in July, 1922, and was appointed assistant mechanical engineer. The following year he was transferred to the Koppel Industrial Car & Equipment Company (subsidiary of the Pressed Steel Car Company) as assistant chief engineer and in February, 1936, returned to the Pressed Steel Car Company, at McKees Rocks, as assistant chief engineer.

C. F. Christopher, open-hearth superintendent of the Railway Steel-Spring Division, American Locomotive Company, has been promoted also to the position of chief metallurgist, made vacant by the death of Paul J. Neely. Mr. Christopher, from 1923 to 1928, was with the Jones & Laughlin Steel Corporation, serving in various positions until he finally became assistant superintendent of one of the open-

C. F. Christopher

hearth departments. He subsequently to 1934 was employed by the U. S. Bureau of Mines, Carnegie Institute of Technology and Metallurgical Advisory Board and then entered the employ of the Railway Steel-Spring Division, American Locomotive Company as open-hearth superintendent.

The Safety Car Heating & Lighting Co., New York, and the Spicer Manufacturing Company, Toledo, Ohio, have made an arrangement under which, hereafter, in addition to the direct gear drive now manufactured and sold by the Spicer Manufacturing Company, that company will also manufacture the Safety Car Heating & Lighting Co.'s Vee belt and gear drive for railway car generators. The Safety Car Heating & Lighting Co. will hereafter market both types of drives. This arrangement has been worked out in order to take advantage of the specialized manufacturing facilities of the Spicer Manufacturing Company, and to avoid the duplication of the Safety Car Heating & Lighting Co.'s existing nation-wide sales and servicing organization.

George H. Weiler has become associated with the Vanadium Corporation of America as manager, Eastern Railroad division, with headquarters in New York

George H. Weiler

City. For a number of years Mr. Weiler was sales manager of the American Locomotive Company, New York; later secretary-manager of the Forging Manufacturers' Association, New York City, and more recently was connected with the Standard Steel Works Company, Burnham, Pa.

The Timken Roller Bearing Company, Canton, Ohio, has announced the following changes in its organization: Frederick J. Griffiths resigned as a director and as president and director of its wholly-owned subsidiary, the Timken Steel & Tube Company. William E. Umstattd, president of the parent company, has been elected also president of the subsidiary, and H. H. Timken, Jr., previously a vice-president of the Timken Steel & Tube Company, has become its executive vice-president, in addition to his capacity as vice-president and director of the Timken Roller Bearing Company. W. Robert Timken has been elected director of both companies to fill Mr. Griffiths' unexpired terms, and John E. Fick has been appointed general superintendent of the steel and tube mills, succeeding K. B. Bowman, resigned.

Obituary

Paul J. Neely, chief metallurgist, Railway Steel-Spring Division, American Locomotive Company, died at Latrobe, Pa., on December 10. Mr. Neely entered the employ of the Latrobe plant in 1903 in the chemical laboratory, and constantly advanced until he became chief metallurgist.

Charles W. Osborne, chairman of the board of directors of the Gold Car Heating & Lighting Company, Brooklyn, N. Y., died on December 1, at his home in Englewood, N. J. Mr. Osborne celebrated his 97th birthday last August and up to this time has been active as a member of the board. He had been with the company since March, 1888, over 48 years ago.

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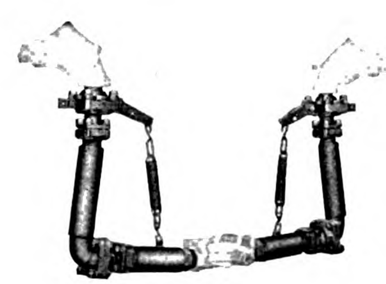

Personal Mention

General

H. W. Reynolds, mechanical inspector of the Norfolk & Western at Roanoke, Va., has been promoted to the position of assistant mechanical engineer.

M. L. Carlson has been appointed superintendent of motive power of the Missouri & Arkansas, with headquarters at Harrison, Ark., to succeed E. A. Shull, who has resigned.

R. M. Pilcher, assistant engineer of tests of the Norfolk & Western, has been promoted to the position of mechanical inspector, with headquarters at Roanoke, Va., to succeed H. W. Reynolds.

Charles A. Gill, superintendent of motive power and rolling equipment of the Reading and the Central of New Jersey at Reading, Pa., has been appointed general manager of these companies, with headquarters at Reading.

E. J. McSweeney, district master mechanic of the Western lines of the Baltimore & Ohio, has been appointed superintendent of motive power of the Western lines, with headquarters as before at Cincinnati, succeeding G. R. Galloway.

M. R. Reed, general superintendent of motive power of the Central Region of the Pennsylvania at Pittsburgh, Pa., has been appointed superintendent of motive power of the Eastern Pennsylvania division.

Thomas W. Demarest, general superintendent of motive power of the Western region of the Pennsylvania, with headquarters at Chicago, Ill., has been assigned to duty on the staff of the chief of motive power at Philadelphia, Pa.

W. Y. Cherry, general superintendent of motive power of the New York zone of the Pennsylvania at New York, has been appointed general superintendent of motive power of the Western region, with headquarters at Chicago, succeeding T. W. Demarest.

G. R. Galloway, superintendent of motive power of the Western lines of the Baltimore & Ohio, with headquarters at Cincinnati, Ohio, has been appointed superintendent of motive power of the Eastern lines, with headquarters at Baltimore, Md., succeeding A. K. Galloway.

E. L. Bachman, master mechanic of the Philadelphia division of the Pennsylvania at Harrisburg, Pa., has been appointed general superintendent of motive power of the New York zone, with headquarters at New York, succeeding W. Y. Cherry.

A. K. Galloway, superintendent of motive power of the Eastern lines of the Baltimore & Ohio, with headquarters at Baltimore, Md., has been appointed superintendent of motive power and rolling equipment of the Reading and the Central of New Jersey, with headquarters at Reading, Pa., succeeding C. A. Gill.

H. H. Haupt, superintendent of motive power of the Eastern and Central Pennsylvania divisions of the Pennsylvania, has been appointed general superintendent of motive power of the Central region, with headquarters at Pittsburgh, Pa., succeeding M. R. Reed.

Master Mechanics and Road Foreman

John B. Halliday, shop superintendent of the Pere Marquette at Wyoming, Mich., has been appointed master mechanic of the Canadian division, with headquarters at St. Thomas, Ont., succeeding Elmer A. Kuhn.

W. F. Harris, general foreman locomotive department of the Western lines of the Baltimore & Ohio at Willard, Ohio, has been appointed master mechanic, with headquarters at Akron, Ohio.

E. M. Caffray, road foreman of engines of the Western Pacific at Oroville, Cal., has been appointed acting master mechanic, with headquarters at the Sacramento (Cal.) shops, to succeed M. T. Saunders, master mechanic, who has been granted a leave of absence.

J. S. Bell, assistant enginehouse foreman of the Pennsylvania at Philadelphia, Pa., has been appointed assistant master mechanic of the Columbus, Cincinnati and Toledo divisions, with headquarters at Columbus, Ohio.

John Dunlevy Davenport, who has been appointed master mechanic of the Chesapeake & Ohio at Hinton, W. Va., as noted in the November issue of the *Railway Mechanical Engineer,* was born on October 22, 1885, at Richmond, Va. He received a high-school education and entered the service of the Chesapeake & Ohio in September, 1902, as a machinist apprentice at Richmond. Upon the completion of his apprenticeship in 1906 he was employed as a machinist until November, 1910, when he was promoted to the position of machine shop foreman. From 1911 until 1920 he was erecting shop foreman at Richmond, during the latter part of this period being employed as inspector for the C. & O. at Schenectady, N. Y., and also as chief locomotive inspector for the Railroad Administration at Pittsburgh, Pa. He became general foreman at the Seventeenth street shops of the C. & O. at Richmond in January, 1920, being transferred to the position of general foreman at Charlottesville, Va., in November of the same year. He became assistant master mechanic of the Fulton shops at Richmond on August 1, 1926, and on February 1, 1932, was transferred back to Charlottesville as general foreman. He was appointed assistant master mechanic at Hinton on July 1, 1933, and master mechanic on October 1, 1936.

J. D. Davenport

Obituary

Robert A. Reid, master mechanic of the Toledo-Ludington division of the Pere Marquette, at Saginaw, Mich., died on Thursday, December 10, at the age of 61. Mr. Reid began his 44 years of service with the Pere Marquette in 1892 as a machinist apprentice. Several years later he became night enginehouse foreman and in 1909 was promoted to the position of general enginehouse foreman. In 1917 he became general foreman of the machine shop at Saginaw and two years later was promoted to shop superintendent. A year later he became assistant master mechanic and in 1923, master mechanic.

R. A. Reid

William Cunningham, chief interchange inspector of the Detroit Car Interchange Inspection Association, died on November 5, 1936. Mr. Cunningham was born on May 8, 1865. He entered the maintenance of way department of the Michigan Central at Dexter, Mich., at the age of nineteen, and the following year entered car department service at Lansing, Mich. He was subsequently moved to Detroit, Mich., in charge of the car department, and later was placed in charge of the car department at Jackson, Mich. Early in the 1900's he returned to Detroit to take charge of passenger-car work. On September 5, 1910, he was placed in charge of the freight car department of the Pere Marquette at Detroit, and on September 16, 1915, was chosen for the position of chief interchange inspector of the Detroit Car Interchange Inspection Association.

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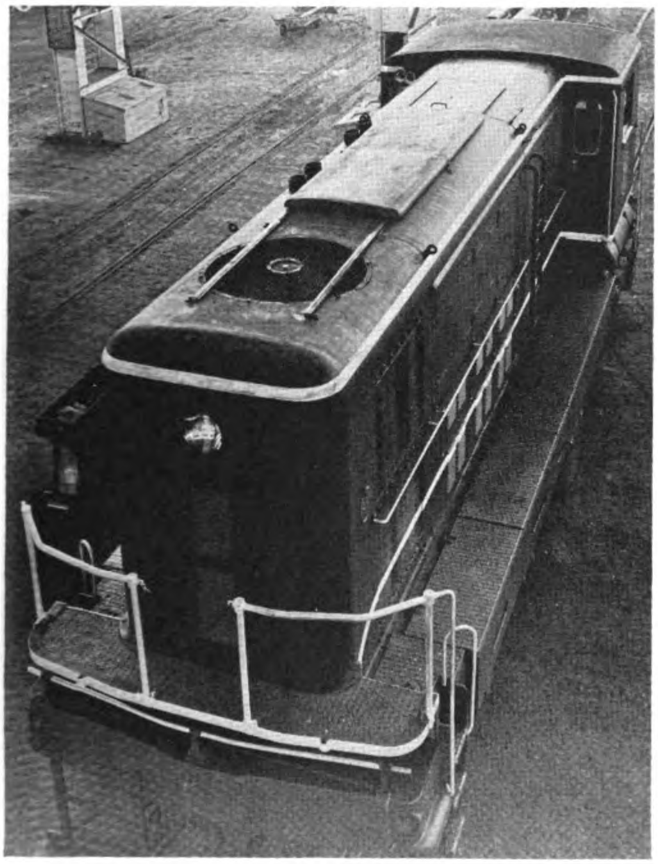
RAILWAY
MECHANICAL ENGINEER

Accessibility of Principal Units a Feature of

Baldwin Diesel Switcher



Top front view of Baldwin 660-hp. Diesel switcher

De La Vergne 660-hp. Diesel engine and Allis-Chalmers electrical equipment installed in Baldwin 100-ton switcher. The design and arrangement of engine and major assemblies make parts readily accessible. Maximum tractive force, 63,600 lb. Speed at continuous rating is 5.7 m. p. h.; maximum speed is 45 m. p. h.

In designing locomotive No. 62,000, a 100-ton Diesel-electric switcher recently completed at its Eddystone (Pa.) plant the Baldwin Locomotive Works paid particular attention to the design and arrangement of engine and major assemblies so as to produce a locomotive in which all parts would be readily accessible. The objective in this design was to develop a locomotive especially suited to the conditions of switching service and one in which maintenance costs would be at a minimum.

The basic feature of the design of the locomotive as a whole is the mounting of the engine, main and auxiliary generators, engine radiators, cooling fans and traction-motor blower on a common subbase, thus assuring accurate alinement. The subbase is an integral steel casting mounted on bolting lugs which are a part of the main underframe of the locomotive. A resilient composition cork-rubber pad is inserted between the subbase and the main underframe to provide protection against rail shock.

This locomotive is powered with a recently-developed design of De La Vergne 660-hp. Diesel engine and Allis-Chalmers electrical equipment. The basic design, however, provides for the use of electrical equipment of other manufacturers, as specified by the purchaser. The locomotive operating alone, is designed to negotiate a curve of 50 ft. radius and, operating with a train, to negotiate a curve having a radius of 120 ft. The maximum speed is 45 m. p. h. The general characteristics of the locomotive are given in the table.

Locomotive No. 62,000 will be used in the immediate future for demonstration service on a number of railroads.

The De La Vergne Engine

The prime mover is a De La Vergne Model VO four-cycle, solid injection, cold starting Diesel engine. It has a cylinder bore of 12½ in., a piston stroke of 15½ in. and is rated at 660 b.hp. at 600 r.p.m.

A feature of this engine is the spherically shaped combustion chamber which is cast integral with the cylinder head and is connected with the cylinder combustion space by a throat. The contour of the chamber and throat is such that air rushing in from the cylinder during the compression stroke creates a turbulence which induces a thorough mixing of the air with the atomized fuel.

The fuel-injection equipment is of the Bosch type with an individual fuel pump for each cylinder and a spray valve which enters the side of each spherical combustion chamber. Direct combustion occurs in this chamber which is offset from the center line of the cylinder and is entirely surrounded by water jacketing. This results in lower operating temperatures of valves, pistons, piston

rings and cylinder liners, complete combustion and advantageous lubrication conditions.

The offset position of the combustion chamber and the elimination of a central vertical spray nozzle permit the use of a large single exhaust and a single inlet valve for each cylinder. The use of two valves, instead of four, simplifies the valve gear and allows a shorter and more compact cylinder block, as well as more space for cooling-water circulation.

The engine frame is a single rigid casting designed to obviate the necessity for through bolts or tie rods. This method of construction makes possible a very rigid and compact cylinder-block casting. Crankshaft-bearing supports are attached to the engine frame. The upper and lower main bearing shells can be taken out while the engine is in place by removal through the crankcase doors. The compact cylinder block makes it possible to reduce the length of the crankshaft.

Piston-ring grooves are cut in an aluminum-bronze collar cast in the aluminum piston. This harder alloy resists wear and lengthens the life of piston and rings as the grooves do not pound out of shape as in the softer metal of the piston body. The absence of a central spray nozzle in the cylinder head makes possible a flat, smooth piston top. Due to low operating temperatures of pistons and adjacent parts there is less expansion and tendency to bind. Therefore, piston diameters can be made closer to cylinder diameters, a feature which prevents excessive rocking of the piston as a result of piston and connecting-rod reactions.

Cylinder liners are lapped into the cylinder block with a metal-to-metal fit.

Engine speed is controlled by a Woodward variable-speed governor which is mechanically connected to the operator's station so that the Diesel engine can be adjusted to any required speed.

Electrical Equipment

The electrical equipment for this locomotive was furnished by the Allis-Chalmers Manufacturing Company. The main generator is driven direct by the Diesel engine, both being mounted on a common base as previously mentioned. The commutator shaft is connected to the engine by means of a self-aligning coupling. The generator is both self-excited and separately excited and is of the self-ventilated, interpole type, furnishing d.c. power to the traction motors at a maximum of 600 volts. The voltage characteristics of the generators are such that, with increasing current, the voltage is reduced so that the maximum current, under any conditions, is only equal to the maximum starting current of the traction motors.

The self-excited, variable-speed auxiliary generator mounted on the main generator shaft delivers full power at from half to full engine speed to all auxiliary motors such as those of the traction-motor blower, radiator fan and air compressor. It also provides current for battery charging.

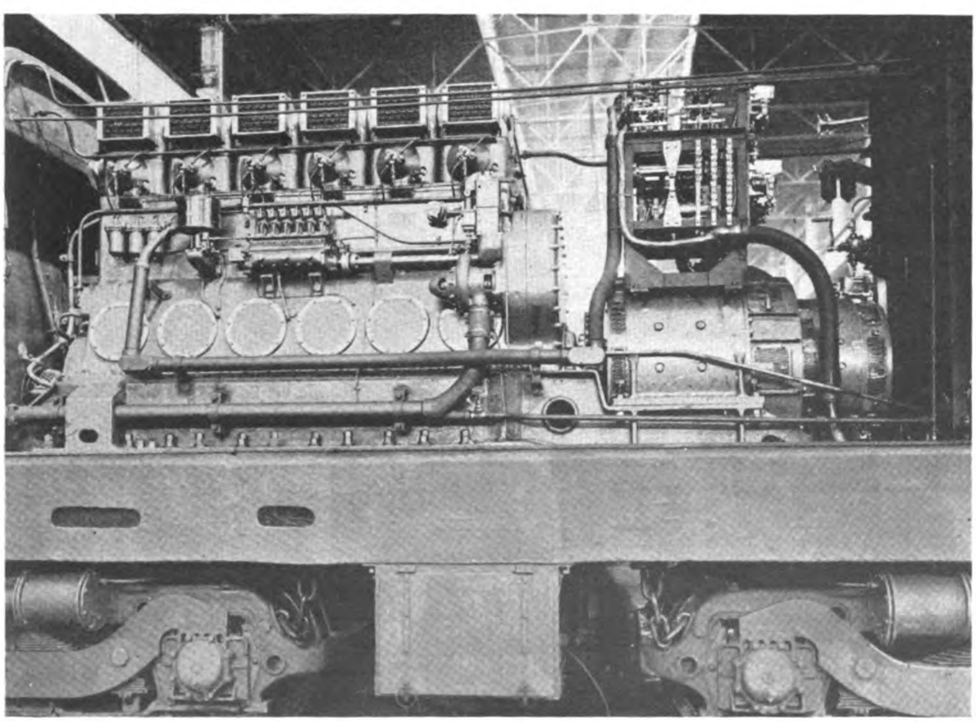
Characteristics of Baldwin Diesel-Electric Switcher

Weight on drivers, loaded, lb.	212,000
Weight on drivers, light, lb.	200,000
Length inside coupler knuckles, ft. and in.	39-6
Height to top of cab, ft. and in.	14-3
Height of engine hood, ft. and in.	14-0
Width overall, ft. and in.	10-2
Width of engine hood, ft. and in.	5-6
Rigid wheel base, ft. and in.	8-0
Total wheel base, ft. and in.	26-0
Fuel oil capacity, gal.	500
Lubricating oil capacity, gal.	130
Water capacity, gal.	248
Sand capacity, lb.	2,200
Tractive force (30 per cent adhesion), lb.	63,600
Tractive force at continuous rating of motors, lb.	29,900
M.p.h. at continuous rating of motors	5.7
Maximum speed, m.p.h.	45.0

A traction-motor blower is mounted under the hood on the subbase casting. Air is delivered to an opening in the main frame which carries it to the two truck center pins. From there it is delivered to the traction motors.

The control is arranged with the four traction motors connected in parallel. This simplifies the control circuits in that no transition from series to series parallel is required. With the parallel connection of traction motors the tendency for continued slipping of the wheels of the locomotive is reduced.

The Allis-Chalmers automatic Servo field regulator is installed on this locomotive. This electro-mechanical device is a main-generator field-excitation regulator interlocked with the Diesel-engine governor and connected



A close-up of the locomotive during construction with the hood removed showing power plant

The underframe is an integral steel casting in which are contained the 500-gal. fuel oil tank, storage-battery compartment, sand boxes and motor air ducts

to a resistor in the circuit of the separately excited field of the main generator. This device regulates the main-generator excitation, not as a function of the electrical conditions, but entirely through the governor of the Diesel engine. It automatically increases the generator voltage as the motor current decreases, so that the engine load is constant at all times within the operating range of the locomotive, regardless of the speed or tractive force.

If one or more Diesel-engine cylinders become inoperative, the main-generator output is automatically reduced to correspond with the reduced engine output so that the engine is not overloaded.

An electrical equipment box is located under the main frame between the trucks. It houses the equipment connected in the main power circuits along with the necessary wiring. The box has hinged doors on all four sides, making wiring and electrical devices easily accessible.

Other Features of Construction

The underframe of the locomotive is an integral steel casting in which are incorporated bolting lugs for the engine-generator subbase, 500-gallon fuel oil tank, storage-battery compartment, sand boxes, cab steps, traction motor air ducts, and housings for draft gear and truck center pins. Storage-battery compartments are easily accessible through trap doors for filling or replacing batteries. The interiors of the compartments are protected with acid-resisting paint.

The four-wheel swivel trucks have integral cast-steel frames, incorporating air passages through the center pin and bolster to the motor inlet. The rolled-steel wheels are 40 in. in diameter. The journals are equipped with Timken roller bearings, but friction bearings can be used on a locomotive of this type if desired. The pedestal ways of the truck frame and boxes are lined with manganese steel and provided with oil pockets to lubricate the wearing faces.

A feature of the truck design is the provision for dropping a set of wheels without removing the traction motor from the axle.

The weatherproof engine hood is of steel plate, having removable top with sliding hatches and removable hinged doors alongside the engine and generator, giving access to parts requiring attention and possible replacement. The entire roof and sides of the hood can be removed if desired. The front section houses the radiators, cooling fan and motor, traction-motor blower and the compressor compartment.

The radiators are mounted vertically in the sides of the hood to prevent blanketing and insure a free circulation of air even though the front of the locomotive may be close against a box car or other high piece of equipment. The radiators have a capacity of 248 gallons of water and sufficient additional capacity to cool the engine lubricating oil. Radiator-fan speed can be controlled by the operator who thus adjusts cooling-water temperature to suit outside weather conditions.

Fuel is pumped from the tank in the main underframe by a geared pump driven by a ¼-hp. motor to filters, mounted in the hood. After going through the filters, the oil passes into an auxiliary tank under the top of the hood. This tank holds 12 gallons and its purpose is to insure a supply of fuel for several hours' operation in case of an accident to the fuel pump. Fuel is fed by gravity from the auxiliary tank to the engine pump, thence to the Bosch fuel pump and sprayed into the combustion chamber.

An emergency hand pump is placed in the fuel-oil line between the main reservoir and the strainer to be used in the rare event that the motor-driven pump fails. An emergency fuel cut-off valve is installed on the locomotive and can be actuated by either one of two handles, one located in the cab and the other on the outside of the frame.

The steel cab is entirely lined and floored with cork. Doors are of pressed steel and window frames are of extruded aluminum. The entire locomotive, including engine, generator, traction motor, auxiliaries, lights and various accessories, is controlled from the cab. The control stand is on the right side. The operator not only has clear vision directly in front of him on the right-hand side, but clear vision is also provided forward along the left-hand side by a suitable mirror. The hood is only 66 in. wide which gives excellent visibility. All doors and windows are weather-stripped and an automatic hot-water heater provides comfort in winter. Windshield wipers and awnings are regular equipment.

The accessories used on this locomotive include the following: Miner A-22XB friction draft gear; Type E A.A.R. swivel-shank top operating couplers; bell with internal quick-acting bell ringer; Pneuphonic horn; Sunbeam 12-in. round-case headlights built into cab and hood, respectively, and King top-operated sanders.

Passenger Cars Air-Conditioned During 1936

Railroad	No. of Cars	Type of Cars	Type of System	Manufacturer	Compressor Drive	Refrigerant	Generators: No.	Generators: Capacity Kw.	Generators: Type of Drive	Generators: Type of Mounting	Storage Batteries: Make	Storage Batteries: Amp.-Hr. Capacity	Outside Power Supply: a.c. or d.c.	Outside Power Supply: Phase	Outside Power Supply: Cycles	Outside Power Supply: Volts
A. T. & S. F.	6	Chair	St. ejec.	Safety C. H. & L.	....	Water	2	1-2 1-5	Flat belt	Truck	Exide	850	....	..	..	...
	8	Chair	St. ejec.	Safety C. H. & L.	....	Water	2	1-2 1-4	Flat belt	Truck	Exide	850	....	..	..	...
	6	Coaches	St. ejec.	Safety C. H. & L.	....	Water		1-5 1-2	Flat belt	Truck	Exide	850	....	..	..	...
	12	Coaches	St. ejec.	Safety C. H. & L.	....	Water	2	1-4 1-2	Flat belt	Truck	Exide	850	....	..	..	...
	1	Diner	St. ejec.	Safety C. H. & L.	....	Water	1	7½	Flat belt	Truck	Exide	850	....	..	..	...
	2	Chair	St. ejec.	Safety C. H. & L.	....	Water	1	7½	Flat belt	Truck	Exide	850	....	..	..	...
	16	Chair	St. ejec.	Safety C. H. & L.	....	Water	2	1-2 1-4	Flat belt	Truck	Exide	850	....	..	..	...
A. C. L.	50	Coaches	St. ejec.	Safety C. H. & L.	....	Water	1	10	Flat belt	Body	Edison	600	....	..	..	...
	3	Diners	St. ejec.	Safety C. H. & L.	....	Water	1	10	Flat belt	Body	Edison	600	....	..	..	...
B. & O.	10	Comb.	Elec.-Mech.	B. & O.-York	Motor	Freon	2	1-4 1-7½	Flat belt Flat belt-gear	Body	Exide, Gould, K. W. and U. S. L.	1,000	....	..	..	...
	2	Comb.	Elec.-Mech.	B. & O.-York	Motor	Freon	2	6	Flat belt	Body	Exide	1,000	....	..	..	...
	1	Coach	Elec.-mech.	B. & O.-York	Motor	Freon	2	6	Flat belt	Body	Exide	1,000	....	..	..	...
	69	Coaches	Elec.-mech.	B. & O.-York	Motor	Freon	2	1-4 1-7½	Flat belt Flat belt-gear	Body	Exide, Gould, K. W. and U. S. L	1,000	....	..	..	...
B. & M.	17	Coach	Ice	Sturtevant	....	Ice	1	4	Flat belt	Body	Edison	256	....	..	..	...
	2	Comb.	Ice	Sturtevant	....	Ice	1	4	Flat belt	Body	Edison	256	....	..	..	...
Can. Nat'l.	3	Diners	Ice	....	....	Ice	1	5	Flat belt in summer—chain in winter.	Truck	Edison, Exide and Gould	600	....	..	..	...
	27	Chair	Ice	....	....	Ice	1	5		Truck						
	26	Sleepers	Ice	....	....	Ice	1	4		Truck						
Can. Pacific	43	Sleepers	Ice	....	....	Ice	1	3	Gear	Body	Gould Kathanode	600	....	..	..	...
	32	Sleepers	Ice	....	....	Ice	1	3	Gear	Body	Edison	595	....	..	..	...
	6	Sleepers	Ice	....	....	Ice	1	3	Gear	Body	Exide	585	....	..	..	...
	6	Sleepers	Ice	....	....	Ice	1	3	Gear	Body	Gould Kathanode	600	....	..	..	...
	3	Sleepers	Ice	....	....	Ice	1	3	Gear	Body	Exide	585	....	..	..	...
	2	Sleepers	Ice	....	....	Ice	1	3	Gear	Body	Edison	680	....	..	..	...
	5	Sleepers	Ice	....	....	Ice	1	3	V-belt-gear	Body	Gould Kathanode	600	....	..	..	...
	1	Sleeper	St. ejec.	....	....	Water	1	7½	V-belt-gear	Body	Gould Kathanode	1,000	....	..	..	...
	10	Obs.-sleeper	Ice	....	....	Ice	1	3	Gear	Body	Edison	595	....	..	..	...
	1	Obs.-sleeper	Ice	....	....	Ice	1	3	V-belt-gear	Body	Edison	595	....	..	..	...
	3	Obs.-sleeper	Mech.	....	V-belt	Freon	1	3	Gear	Body	Edison	595	....	..	..	...
	4	Obs.-lounge	Mech.	....	V-belt	Freon	1	5	Flat belt	Body	Edison	680	....	..	..	...
	2	Lounge-sleeper	Ice	....	....	Ice	1	4	Gear	Body	Exide	585	....	..	..	...
	3	Diners	Ice	....	....	Ice	1	5	Gear	Body	Exide	585	....	..	..	...
	8	Coaches	Ice	....	....	Ice	1	4	Gear	Body	Edison	510	....	..	..	...
	4	Comb.	Ice	....	....	Ice	1	4	Gear	Body	Edison	510	....	..	..	...
	2	Chair	Ice	....	....	Ice	1	5	Gear	Body	Exide	585	....	..	..	...
	2	Chair	Ice	....	....	Ice	1	5	Gear	Body	Edison	595	....	..	..	...
	2	Chair	Electro-mech.	....	Motor	Freon	1	20	Gear	Body	Edison	1,190	....	..	..	...
	2	Chair-buffet	Ice	....	....	Ice	1	5	Gear	Body	Exide	585	....	..	..	...
Cen. of Ga.	9	Coaches	St. ejec.	Safety C. H. & L.	....	Water	1	10	Flat belt	Body	Edison	750	....	..	..	...
C. R. R. of N. J.	2	Comb.	Elec.-mech.	York	Motor	Freon	2	1-3 1-7½	Flat belt	Body	Edison	1,000	a. c.	3	60	220/440
	3	Coaches	Elec.-mech.	York	Motor	Freon	2	1-2 1-7½	Flat belt	Body	Edison	1,000	a. c.	3	60	220/440
C. & O.	2	Comb.	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	3	Flat belt	Body	Exide	350	a. c.	3	60	220
	2	Comb.	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	3	Flat belt	Body	U. S. L.	350	a. c.	3	60	220
	6	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Exide	500	a. c.	3	60	220
	3	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	3	Flat belt	Body	Exide	350	a. c.	3	60	220
	2	Diners	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Exide	500	a. c.	3	60	220
C. & E. I.	9	Coaches	St. ejec.	Safety C. H. & L.	....	Water	1	10	V-belt-gear	Body	Gould	950	....	..	..	...
	1	Diner	Ice	Safety C. H. & L.	....	Ice	1	3	Flat belt	Body	U. S. L.	500	....	..	..	...

Passenger Cars Air-Conditioned During 1936 (Continued)

Railroad	No. of Cars	Type of Cars	Type of System	Manufacturer	Compressor Drive	Refrigerant	Generator: No.	Generator: Capacity Kw.	Generator: Type of Drive	Generator: Type of Mounting	Storage Batteries: Make	Storage Batteries: Amp.-Hr. Capacity	Outside Power Supply: a.c. or d.c.	Outside Power Supply: Phase	Outside Power Supply: Cycles	Outside Power Supply: Volts
C. & N. W.	2	Cafe-chair	Ice	Trane	....	Ice	..	..	....	......	......	....	....	..	..	...
	23	Coaches	Mech.	Waukesha	Gas engine	Freon	..	..	....	......	......	....	....	..	..	...
	6	Chair	Mech.	Waukesha	Gas engine	Freon	..	..	....	......	......	....	....	..	..	...
	11	Diners	Mech.	Waukesha	Gas engine	Freon	..	..	....	......	......	....	....	..	..	...
	3	Lounge	Mech.	Waukesha	Gas engine	Freon	..	..	....	......	......	....	....	..	..	...
C. B. & Q.	8	Coaches	Elec.-mech.	Trane	Motor	Freon	1	20	V-belt-gear	Body	Lead	1,000	a. c.	3	60	220
	4	Lounge	Elec.-mech.	Frigidaire	Motor	Freon										
	4	Diners	Elec.-mech.	Frigidaire	Motor	Freon	Three 50-kw. generators on each of two 7-car streamlined trains and four 50-kw. generators on each of two 12-car trains, driven by auxiliary Diesel engines.									
	4	Chair-lounge	Elec.-mech.	Frigidaire	Motor	Freon							a. c.	3	60	220
	2	Chair	Elec.-mech.	Frigidaire	Motor	Freon										
	8	Sleepers	Elec.-mech.	Frigidaire	Motor	Freon										
C. M. St. P. & P.	2	Diner	St. ejec.	Safety C. H. & L.	....	Water	1	10	V-belt	Truck	Exide	850	....	..	..	...
	2	Lounge	St. ejec.	Safety C. H. & L.	....	Water	1	10	V-belt	Truck	Exide	850	....	..	..	...
	13	Chair	St. ejec.	Safety C. H. & L.	....	Water	1	10	V-belt	Truck	Exide	850	....	..	..	...
	17	Coaches	St. ejec.	Safety C. H. & L.	....	Water	1	10	V-belt	Truck	Exide	850	....	..	..	...
	2	Sleepers	Mech.	Waukesha	Gas engine	Freon	1	4	V-belt	Body	Exide	450	....	..	..	...
	37	Sleepers	St. ejec.	Safety C. H. & L.	....	Water	1	10	V-belt	Truck	Exide	850	....	..	..	...
C. R. I. & P.	49	Coaches	Ice	A. C. F.	....	Ice	1									
	16	Chair	Ice	A. C. F.	....	Ice	1	2.6, 3 or 4	Flat belt	Body	......	450	....	..	..	...
	4	Diners	Ice	A. C. F.	....	Ice	1									
	2	Diners	Mech.	Waukesha	Gas engine	Freon	1	4	Flat belt	Body	U. S. L.	450	....	..	..	...
D. & H.	1	Chair-cafe	Ice	Safety C. H. & L.	....	Ice	..	..	....	......	Exide	500	....	..	..	...
	3	Diners	Ice	Safety C. H. & L.	....	Ice	..	..	....	......	Exide	500	....	..	..	...
D. L. & W.	5	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	3	Flat belt	Body	Lead	450	a. c.	3	60	220
	5	Coaches	Elec.-mech.	Airtemp	Motor	Freon	1	20	V-belt-gear	Body	Edison	1,000	a. c.	3	60	220
	2	Diners	Ice	Safety C. H. & L.	....	Ice	1	4	Flat belt	Body	Lead	450	....	..	..	...
D. & R. G. W.	3	Lounge-diners	Ice	Young	....	Ice	1	4	Flat belt	Body	K. W.	520	....	..	..	...
	5	Coaches	Ice	Young	....	Ice	1	4	Flat belt	Body	K. W.	520	....	..	..	...
Erie	1	Business	Mech.	P. S. C. M. C.	Speed reducer	Freon	2	4½	....	......	Edison	....	a. c.	3	60	220
Fla. East Coast	8	Coaches	St. ejec.	Safety C. H. & L.	....	Water	2	1-3 1-4	Flat belt	Body	Edison	600	....	..	..	...
	10	Coaches	St. ejec.	Safety C. H. & L.	....	Water	1	10	Flat belt	Body	Edison	600	....	..	..	...
	3	Diners	St. ejec.	Safety C. H. & L.	....	Water	2	1-3 1-5	Flat belt	Body	Edison	750	....	..	..	...
Gr. Northern	4	Coaches	Ice	R. R. Co.	....	Ice	1	4	V-belt	Body	2 Exide; 2 Gould	500	....	..	..	...
	4	Diners	Ice	R. R. Co.	....	Ice	1	4	V-belt	Body	Exide	500	....	..	..	...
Ill. Cent.	3	Business	Ice	A. C. F.	....	Ice	2	3	Flat belt	Body	Edison	900	....	..	..	...
	57	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	3	Flat belt	Body						
	3	Chair	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	3	Flat belt	Body	41 Edison; 21 Lead	375	a. c.	3	60	220
	1	Cafe-lounge	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	3	Flat belt	Body						
	1	Comb.	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	3	Flat belt	Body						
L. & N.	39	Coaches	St. ejec.	Safety C. H. & L.	....	Water	1	10	Flat belt	Body	Exide and Edison	800	....	..	..	...
Maine Cent.	5	Coaches	Ice	Sturtevant	....	Ice	1	4	Flat belt	Body	Edison	340	....	..	..	...
M. St. P. & S. Ste. M.	3	Diners	Mech.	Waukesha	Gas engine	Freon	1	3	Flat belt	Body	Gould	600	....	..	..	...
	4	Lounge	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Gould	600	a. c.	3	60	220
Mo. Pac.	5	Comb.	Ice	R. R. Co.	....	Ice	1	3	Flat belt	Body	Edison	375	....	..	..	...
	3	Comb.	Ice	R. R. Co.	....	Ice	1	4	Flat belt	Body	Edison	300	....	..	..	...
	3	Chair	Ice	R. R. Co.	....	Ice	1	4	Flat belt	Body	Edison	375	....	..	..	...
	1	Chair	Ice	R. R. Co.	....	Ice	1	3	Flat belt	Body	Edison	600	....	..	..	...
	5	Chair	St. ejec.	Safety C. H. & L.	....	Water	2	4	Flat belt	Body	Edison	750	....	..	..	...
	18	Chair	Ice	R. R. Co.	....	Ice	5-1	4	Flat belt	Body	Edison	3-600 11-375	....	..	..	...
							13-2	3	Flat belt	Body	Edison	4-450	....	..	..	...

Passenger Cars Air-Conditioned During 1936 (Continued)

Railroad	No. of Cars	Type of Cars	Type of System	Manufacturer	Compressor Drive	Refrigerant	Generators: No.	Generators: Capacity Kw.	Generators: Type of Drive	Generators: Type of Mounting	Storage Batteries: Make	Storage Batteries: Amp.-Hr. Capacity	Outside Power Supply: a.c. or d.c.	Outside Power Supply: Phase	Outside Power Supply: Cycles	Outside Power Supply: Volts
Mo. Pac. (Continued)	7	Grill-coaches	Ice	R. R. Co.	....	Ice	1	4	Flat belt	Body	Edison	375	....	..	..	...
	1	Coach-diner	Elec.-mech.	Frigidaire	Motor	Freon	1	20	V-belt-gear	Body	Edison	1,000	a. c.	3	60	220
	2	Cafe-coach	St. ejec.	Safety C. H. & L.	....	Water	2	4	Flat belt	Body	Edison	750	....	..	..	...
	5	Cafe-coach	Ice	R. R. Co.	....	Ice	1	4	Flat belt	Body	Edison	375	....	..	..	...
	2	Chair-diners	Elec.-mech.	Frigidaire	Motor	Freon	1	15	V-belt-gear	Body	Gould	1,000	a. c.	3	60	220
	3	Chair-diners	St. ejec.	Safety C. H. & L.	....	Water	2	4	Flat belt	Body	Edison	750	....	..	..	...
	4	Chair-diners	Ice	R. R. Co.	....	Ice	2	3	Flat belt	Body	Edison	450	....	..	..	...
	1	Coach-diner	Ice	R. R. Co.	....	Ice	1	4	Flat belt	Body	Edison	375	....	..	..	...
	1	Lounge-diner	Ice	R. R. Co.	....	Ice	2	3	Flat belt	Body	Edison	375	....	..	..	...
	4	Coach	St. ejec.	Safety C. H. & L	....	Water	2	4	Flat belt	Body	Edison	750	....	..	..	...
	62	Coach	Ice	R. R. Co.	....	Ice	36-1 26-2	4 3	Flat belt Flat belt	Body Body	Edison Edison	35-375 2-450 25-600	....	.. .. ..	.. .. ..	... ...
	2	Coach-chair	St. ejec.	Safety C. H. & L	....	Water	2	4	Flat belt	Body	Edison	750	....	..	..	...
	1	Business	Elec.-mech.	Frigidaire	Motor	Freon	2	1-10 1-20	Gear	1-Body 1-Truck	Gould	2,000	a. c.	3	60	220
	4	Business	Ice	R. R. Co.	....	Ice	2	4	Flat belt	Body	Edison	750	....	..	..	...
	3	Lounge-diners	Elec.-mech.	Westinghouse	Motor	Freon	1	20	V-belt-gear	Body	Edison	1,000	a. c.	3	60	220
	3	Lounge-diners	Elec.-mech.	Frigidaire	Motor	Freon	2	20	V-belt-gear	Body	Edison	1,000	a. c.	3	60	220
		Lounge-diners	St. ejec.	Safety C. H. & L.	....	Water	1 2-2 4-2 1-1	15 4 1-10 1-4 10	Flat belt V-belt-gear V-belt-gear	Body	Edison	3-750 4-975	....	.. ..	.. ..	... ...
	1	Diner	Mech.	Waukesha	Gas engine	Freon	2	3	Flat belt	Body	Edison	375	....	..	..	...
	5	Diners	Elec.-mech.	Frigidaire	Motor	Freon	4-1 1-1	20 15	V-belt-gear	Body	3 Exide and 2 Edison	1,000	a. c.	3	60	220
	1	Diner	St. ejec.	Safety C. H. & L.	....	Water	2	4	Flat belt	Body	Edison	750	....	..	..	...
N. C. & St. L.	1	Diner	St. ejec.	Safety C. H. & L.	....	Water	1	10	Flat belt	Body	Edison	850	....	..	..	...
	7	Coaches	St. ejec.	Safety C. H. & L.	....	Water	1	10	Flat belt	Body	Edison	850	....	..	..	...
N. Y. C. System	28	Diners	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Truck	Exide, Gould and K. W.	600 at 64 v.	....	..	..	...
	1	Diner	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Gould	600 at 64 v.	a. c.	3	60	220
	3	Coaches	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Exide, Gould	600 at 64 v.	a. c.	3	60	220
	25	Coaches	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Truck	Exide, K. W. and U. S. L.	600 at 64 v.	....	..	..	...
	1	Comb.	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Gould	600 at 64 v.	a. c.	3	60	220
	1	Kitchen-coach	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Exide	600 at 64 v.	a. c.	3	60	220
	1	Lounge	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Exide	600 at 64 v.	a. c.	3	60	220
	1	Chair	Elec.-mech	Frigidaire	Motor	Freon	1	20	Gear	Body	Gould	600 at 64 v.	a. c.	3	60	220
	1	Obs.-chair	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Exide	600 at 64 v.	a. c.	3	60	220
N. Y. C. & St. L.	2	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	V-belt	Body	Exide	286	a. c.	3	60	220
N. Y., N. H. & H.	46	Coaches	Ice	Sturtevant	....	Ice	..	..	....	......	Exide	450	....	..	..	...
	50	Coaches	Elec.-mech.	Frigidaire	Motor	Freon	1	20	V-belt-gear	Body	Exide	500	30-a. c. 20-none	3 ..	60 ..	220 ...
	15	Coaches	Elec.-mech.	Safety C. H. & L.	Motor	Freon	1	15	V-belt-gear	Body	Exide	1,000	....	..	..	...
	1	Comb.	Ice	Safety C. H. & L.	....	Ice	..	..	....	......	Exide	450	....	..	..	...
	1	Club	Ice	Sturtevant	....	Ice	..	..	....	......	Exide	322	....	..	..	...
	4	Diners	Ice	Safety C. H. & L.	....	Ice	..	..	....	......	Exide	500	....	..	..	...
	1	Comb.	Elec.-mech.	Safety C. H. & L.	Motor	Freon	Note: Two-car steam rail train. One 25 kw. generator driven by auxiliary steam engine supplies train power.				Exide	1-225 for train	....	..	..	...
	1	Coach	Elec.-mech.	Safety C. H. & L.	Motor	Freon							....	..	..	...
N. & W.	38	Coaches	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Edison	300 at 110 v.	a. c.	3	60	220
	2	Coaches	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Lead	300 at 110 v.	a. c.	3	60	220
	7	Comb.	Elec.-mech.	Frigidaire	Motor	Freon	1	20	Gear	Body	Edison	300 at 110 v.	a. c.	3	60	220
	3	Business	Ice	Trane	....	Ice	1	20	V-belt-gear	Body	Lead	300 at 110 v.	....	..	..	...
Nor. Pac.	4	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	V-belt	Body	Exide	600	a. c.	3	60	220
	2	Chair	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	V-belt	Body	Gould	600	a. c.	3	60	220
	2	Diners	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	V-belt	Body	Gould	600	a. c.	3	60	220
Pennsylvania	94	Coaches	Ice	R. R. Co.	....	Ice	1	4.8	Flat belt	Body	......	500	....	..	..	...
	23	Comb.	Ice	R. R. Co.	....	Ice	1	4.8	Flat belt	Body	......	500	....	..	..	...
	13	Diners	Elec.-mech.	Frigidaire	Motor	Freon	1	15	11-Gear 2-V-belt	Body	......	800	....	..	..	...
	3	Diners	Elec.-mech.	Airtemp	Motor	Freon	1	15	V-belt	Body	......	800	....	..	..	...

Passenger Cars Air-Conditioned During 1936 (Continued)

Railroad	No. of Cars	Type of Cars	Type of System	Manufacturer	Compressor Drive	Refrigerant	Generators No.	Generators Capacity Kw.	Generators Type of Drive	Generators Type of Mounting	Storage Batteries Make	Storage Batteries Amp.-Hr. Capacity	Outside Power Supply a.c. or d.c.	Phase	Cycles	Volts
Pullman Co.	24	Sleepers	Elec.-mech.	P. S. C. M. C.	Motor	Freon	2	1-15 1-4	V-belt-gear Flat belt	Body	Exide	1,000	a. c.	3	60	220
	3	Chair	Elec.-mech.	P. S. C. M. C.	Motor	Freon	2	1-15 1-4	V-belt-gear Flat belt	Body	Exide	1,000	a. c.	3	60	220
	16	Sleepers	Elec.-mech.	P. S. C. M. C.	Motor	Freon	Note: Four streamlined trains. Two 75-k. w. Diesel-engine-driven generators on two 11-unit trains; three 75-k. w. Diesel-engine-driven generators on two 12-unit trains.				Exide	2-450 on each train	a. c.	3	60	220
	492	Sleepers	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Exide	550	a. c.	3	60	220
	5	Sleepers	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	7½	V-belt-gear	Body	Exide	550	a. c.	3	60	220
	2	Sleeper	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Exide	600	a. c.	3	60	220
	1	Sleeper	Mech.	P. S. C. M. C.	Speed reducer	Freon	..	..	....	......	....	....	a. c.	3	60	220
	8	Chair	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Exide	550	a. c.	3	60	220
	15	Sleepers	St. ejec.	Safety C. H. & L.	....	Water	1	4	Flat belt	Body	Exide	850	....	..	..	...
	332	Sleepers	Ice	Pullman	....	Ice	1	4	Flat belt	Body	Exide	600	....	..	..	...
	1	Sleepers	Ice	Pullman	....	Ice	1	4	Flat belt	Body	Exide	550	....	..	..	...
	2	Sleepers	Ice	Pullman	....	Ice	1	7½	V-belt-gear	Body	Exide	600	....	..	..	...
	17	Chair	Ice	Pullman	....	Ice	1	4	Flat belt	Body	Exide	600	....	..	..	...
Reading	3	Comb.	Elec.-mech.	York	Motor	Freon	2	1-3 1-7½	Flat belt	Body	2 Exide; 1 K. W.	1,000	a. c.	3	60	220/440
	2	Cafe	Elec.-mech.	York	Motor	Freon	2	1-4 1-7½	Flat belt	Body	Exide	1,000	a. c.	3	60	220/440
	11	Coaches	Elec.-mech.	York	Motor	Freon	2	1-3 1-7½	Flat belt	Body	3 Exide; 3 K. W.; 5 U. S. L.	1,000	a. c.	3	60	220/440
St. L.-S. F.	11	Coaches	Ice	R. R. Co.	....	Ice	1	4	Flat belt	Body	9 Exide; 2 U. S. L.	450	....	..	..	...
	1	Coach	Ice	R. R. Co.	....	Ice	1	4	Flat belt	Body	K. W.	540	....	..	..	...
	1	Coach	Mech.	Waukesha	Gas engine	Freon	1	4	Flat belt	Body	Exide	450	....	..	..	...
	1	Buffet	Ice	R. R. Co.	....	Ice	1	4	V-belt	Body	Exide	450	....	..	..	...
	2	Cafe-lounge	Ice	R. R. Co.	....	Ice	1	5	V-belt	Body	Exide	860	....	..	..	...
S. A. L.	3	Coaches	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Edison	375	a. c.	3	60	220
	3	Rail cars	Mech.	A. C. F.	Gasoline engine	Freon	..	..	....	....	....	....	....	..	..	...
	1	Business	Elec.-mech.	Waukesha	Motor	Freon	1	10	Gear	Body	Edison	900	a. c.	3	60	220
	1	Business	Elec.-mech.	Waukesha	Motor	Freon	1	10	V-belt-gear	Body	Edison	900	a. c.	3	60	220
Sou. Pac.	4	Coaches	Mech.	Waukesha	Gas engine	Freon	1	4	Flat belt	Body	Edison	375	....	..	..	...
	15	Chair	Ice	R. R. Co.	....	Ice	1	4	Flat belt	Body	Edison	375 to 450	....	..	..	...
	12	Coaches	Ice	R. R. Co.	....	Ice	1	4	Flat belt	Body	Edison		....	..	..	...
	2	Cafe	Ice	R. R. Co.	....	Ice	1	4	Flat belt	Body	Edison		....	..	..	...
	14	Diners	Ice	R. R. Co.	....	Ice	1	4 Kw. flat-belt, body-hung drives and 5 Kw. V-belt truck-mounted drives.			Edison	450	....	..	..	...
	13	Lounge	Ice	R. R. Co.	....	Ice	1				Edison	600 to 750	....	..	..	...
	1	Cafe-coach	Ice	R. R. Co.	....	Ice	1				Edison	375 to 600	....	..	..	...
	4	Cafe-lounge	Ice	R. R. Co.	....	Ice	1				Edison	450	....	..	..	...
	48	Coaches	Ice	R. R. Co.	....	Ice	1				Edison	375 to 600	....	..	..	...
	6	Chair	Ice	R. R. Co.	....	Ice	1				Edison	375 to 600	....	..	..	...
Southern	7	Diners	St. ejec.	Safety C. H. & L.	....	Water	1	7.5	Flat belt	Body	Exide	600	....	..	..	...
Tex. & Pac.	4	Coaches	Mech.	Waukesha-Sturtevant	Gas engine	Freon	1	4	Flat belt	Body	Edison	600	....	..	..	...
	1	Coach	Ice	R. R. Co.-Sturtevant	....	Ice	1	4	Flat belt	Body	Edison	600	....	..	..	...
	1	Business	Mech.	Waukesha-Sturtevant	Gas engine	Freon	1	10	Flat belt	Body	Edison	900	....	..	..	...
Union Pac.	10	Diners	St. ejec.	Safety C. H. & L.	....	Water	2	5	Flat belt	Body	Exide	1,000	....	..	..	...
	2	Chair	Elec.-mech	General Electric	Motor	Freon	1	20	V-belt-gear	Body	Exide	1,000	a. c.	3	60	220
	20	Chair	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Edison	500	a. c.	3	60	220
	2	Obs.	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	4	Flat belt	Body	Edison	500	a. c.	3	60	220
Wabash	30	Coaches	Ice	R. R. Co.	....	Ice	25-1 5-1	3 4	Flat belt Flat belt	Body Body	3 Edison; 15 Exide; 1 Gould 8 K. W. and 3 U. S. L.	300 to 540	....	..	..	...
	5	Diners	Ice	R. R. Co.	....	Ice	1	4	Flat belt	Body	2 Edison; 1 Gould; 1 K. W. and 1 U. S. L.	300 to 540	....	..	..	...
	4	Cafe-chair	Ice	R. R. Co.	....	Ice	1	4	Flat belt	Body	1 Edison; 1 K. W. and 2 U. S. L.	426 to 540	....	..	..	...
	11	Cafe-lounge	Ice	R. R. Co.	....	Ice	2-1 9-1	3 4	Flat belt	Body	2 Edison; 4 Exide and 5 U. S. L.	350 to 512	....	..	..	...
	2	Buffet-chair	Ice	R. R. Co.	....	Ice	1	4	Flat belt	Body	Gould	300	....	..	..	...
	2	Business	Ice	R. R. Co.	....	Ice	1	5	Flat belt	Body	Edison	512	....	..	..	...
West. Pac.	3	Coaches	St. ejec.	Safety C. H. & L.	....	Water	2	1-3 1-5	Flat belt	Body	Edison	900	....	..	..	...
	1	Diner	St. ejec.	Safety C. H. & L.	....	Water	2	1-4 1-5	Flat belt	Body	Edison	750	....	..	..	...
	3	Obs.-lounge	Mech.	P. S. C. M. C.	Speed reducer	Freon	1	..	Flat belt	Body	Edison	750	....	..	..	...

Summary of Cars Air Conditioned During 1936

	Number of Cars	Type of Car: Coach	Combination	Dining (Note A)	Chair (Note B)	Observation	Sleeping (Note C)	Business	Type of System: Electro-Mech.	Direct Mech.	Ice	Steam Ejector	Refrigerant Used: Freon	Water	Ice
A. T. & S. F.	51	18	...	1	32	...	...	...	...	...	...	51	...	51	...
A. C. L.	53	50	...	3	...	...	...	...	...	...	...	53	...	53	...
B. & O.	82	70	12	...	...	...	...	...	82	...	...	...	82	...	...
B. & M.	19	17	2	...	...	...	...	...	...	...	19	...	...	...	19
Can. Nat'l	56	...	...	3	27	...	26	...	...	...	56	...	...	...	56
Can. Pac.	141	8	4	5	6	4	114	...	2	7	131	1	9	1	131
C. of Ga.	9	9	...	...	...	...	...	...	...	...	...	9	...	9	...
C. of N. J.	5	3	2	...	...	...	...	...	5	...	...	...	5	...	...
C. & O.	15	9	4	2	...	...	...	...	...	15	...	...	15	...	...
C. & E. I.	10	9	...	1	...	...	...	...	...	...	1	9	...	9	1
C. & N. W. (incl. C. St. P. M. & O.)	45	23	...	13	6	3	...	...	...	43	2	...	43	...	2
C. B. & Q. (incl. Ft. W. & D. C.)	30	8	...	8	6	...	8	...	30	...	...	...	30	...	...
C. M. St. P. & P.	73	17	...	2	13	2	39	...	...	2	...	71	2	71	...
C. R. I. & P.	71	49	...	6	16	...	...	...	...	2	69	...	2	...	69
D. & H.	4	...	...	4	...	...	...	...	...	...	4	...	...	...	4
D. L. & W.	12	10	...	2	...	...	...	...	5	5	2	...	10	...	2
D. & R. G. W.	8	5	...	3	...	...	...	...	...	...	8	...	...	...	8
Erie	1	...	...	...	...	...	...	1	...	1	...	...	1	...	...
F. E. C.	21	18	...	3	...	...	...	...	...	...	...	21	...	21	...
Great Nor.	8	4	...	4	...	...	...	...	...	...	8	...	...	...	8
Ill. Cen.	65	57	1	1	3	...	...	3	...	62	3	...	62	...	3
L. & N.	39	39	...	...	...	...	...	...	...	...	...	39	...	39	...
Me. Cen.	5	5	...	...	...	...	...	...	...	...	5	...	...	...	5
M. St. P. & S. Ste. M.	7	...	...	3	...	4	...	...	...	7	...	...	7	...	...
Mo. Pac.	154	66	8	46	29	...	...	5	15	1	114	24	16	24	114
N. C. & St. L.	8	7	...	1	...	...	...	...	...	...	...	8	...	8	...
N. Y. C. System	62	28	1	30	2	1	...	...	62	...	...	...	62	...	...
N. Y. C. & St. L.	2	2	...	...	...	...	...	...	...	2	...	...	2	...	...
N. Y. N. H. & H.	119	112	2	4	...	1	...	...	67	...	52	...	67	...	52
Nor. & West.	50	40	7	...	...	...	...	3	47	...	3	...	47	...	3
Nor. Pac.	8	4	...	2	2	...	...	...	...	8	...	...	8	...	...
Pennsylvania	133	94	23	16	...	...	...	...	16	...	117	...	16	...	117
Pullman Co.	918	...	...	...	28	...	890	...	43	508	352	15	551	15	352
Reading	16	11	3	2	...	...	...	...	16	...	...	...	16	...	...
St. L.-S. F.	16	13	...	3	...	...	...	...	...	1	15	...	1	...	15
Seaboard A. L.	8	6	...	...	...	...	...	2	2	6	...	...	8	...	...
Southern	7	...	...	7	...	...	...	...	...	...	...	7	...	7	...
Sou. Pac.	119	64	...	21	21	13	...	...	...	4	115	...	4	...	115
Tex. & Pac.	6	5	...	...	...	...	...	1	...	5	1	...	5	...	1
Union Pac.	34	...	...	10	22	2	...	...	2	22	...	10	24	10	...
Wabash	54	30	...	22	...	...	...	2	...	...	54	...	...	...	54
West. Pac.	7	3	...	1	...	3	...	...	...	3	...	4	3	4	...
	2,551	913	69	229	213	33	1,077	17	394	704	1,131	322	1,098	322	1,131

Note A—Includes lounge-diners, coach-diners, cafe-chair, cafe-coach, kitchen-coach and buffet cars.
Note B—Includes lounge-chair, coach-chair and observation-chair cars.
Note C—Includes lounge- and observation-sleepers.

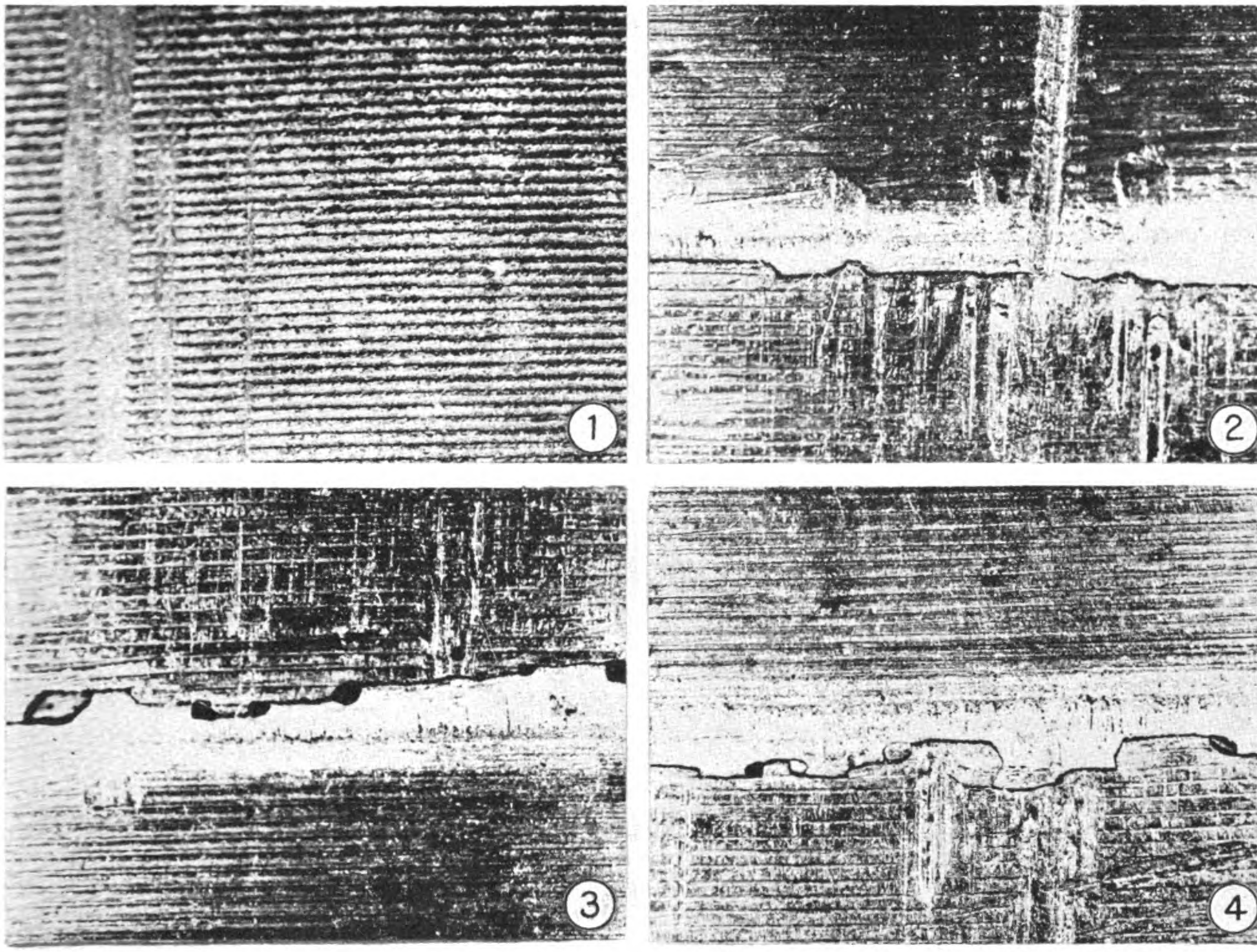


Fig. 1—Surface of the taper fit of a piston rod, enlarged about six times. A prolific cause of failures. Figs. 2, 3 and 4—Fractures caused by the rough finish of the taper fit of piston rods (enlarged about six times).

Failures of

Locomotive Parts*

By F. H. Williams†

THE finish of the taper fit of a piston rod is of first importance, and yet this is too frequently overlooked in these days of speed in production of repair jobs. Judging from the number of failures chargeable to this cause, we can profit greatly by making it a subject of thorough study and research, and of a campaign of education in the repair shops and enginehouses.

Formerly there were occasional failures because of poorly made fillets, where the rod is enlarged for the taper fit in the crosshead. One instance was called to my attention where the roughing cuts left almost a series of steps between the shank of the rod and the taper fit. As a matter of fact, the life of this particular rod was just about two miles—the piston head then went out of the end of the cylinder.

Today special attention is given to the finish of these fillets, with the result that failures at this point have practically disappeared. We cannot, however, be satisfied until the failures of all kinds are eliminated. The greatest progress can, of course, be made by tackling the points of greatest weakness. Many failures are caused by poor finish of the taper of the piston rod which fits into the crosshead. One type of such failures was considered in the preceding article of this series. It is true that there are now fewer failures in the taper fit than for-

* Part eight of an article which began in the May, 1936, issue.
† Assistant test engineer, Canadian National Railways.

merly, but we cannot be satisfied until conditions are improved to a point which will eliminate them entirely.

An example of the kind of finish we do not want to have on the taper fit is shown in Fig 1. This is a magnification of about six diameters; the cutting tool made about 70 threads to the inch. There is no question but what there are hundreds of such rods in service. As a matter of fact, I have seen some shopmen who argued that this was a satisfactory and proper finish, yet there is little question in my mind but what it has been the cause of many failures.

Several failures which were caused by cracks starting from such rough machining are shown in Figs. 2, 3 and 4. It is rather startling to note the way in which the cracks follow along the tool marks. I have known instances where the crack followed the tool marks half way around the circumference of the rod. Aside from the failures of such poorly finished taper fits, it is doubtful if the fit in the crosshead is at all comparable with a smooth finished job.

Improper Taper Fits

A taper fit which was poorly finished and filed and which failed in service is shown in Figs. 5 and 6. This fracture started with a fatigue crack, the progress of which was at first slow. Quite obviously the finish is crude, and yet I have seen worse jobs, which, needless to say, would not have come to my attention had they not been the cause of eventual failure. It will be noted in Fig. 5 that while the fatigue crack started from the surface, some distance from the keyway, the final break passed through the end of the keyway. That the finish of the hole which was drilled in the keyway was not above criticism, is indicated by the score marks which clearly appear on its walls. Let me emphasize the fact that the inferior workmanship above mentioned is not confined to any one shop or to any one road. Examples similar to those illustrated will be found in many places.

A piston rod which disclosed several cracks in the taper fit and which was withdrawn from service before the rod failed, is shown in Figs. 7 and 8. The fatigue cracks are not very pronounced, but may be seen between the daubs of paint. In all instances they followed the tool marks and undoubtedly would have resulted in a complete fracture in a very short time, had they not been discovered when the engine was being repaired. It will be noted that there were cracks about midway on the taper fit on both sides of the rod and that there were also cracks just ahead of the keyway. In the latter case the corrosion band shows clearly, and the cracks are undoubtedly due to a combination of tool marks and stress-corrosion. It will also be noted that the edges of the keyway are sharp, and not rounded as they should be. It is apparent, also, that the rod did not fit properly, since the tool marks are practically rubbed out on part of the taper fit, but were affected very little, if at all on the lower part.

The standard practice in our shops is now to fit the crosshead to a pin ground to the proper taper, and the taper fit on the piston rod to a sleeve. These gages are carefully checked and hardened, and it is thus possible to maintain a standard taper fit both on the piston rod and in the crosshead. As a result of this improvement there has been a marked reduction in failures.

An interesting fracture is shown in Figs. 9, 10 and 11. A close examination of the taper fit on the rod indicated rough filing of the surface. The fatigue cracks started from this rough finish, and to the left of the end of the keyway. The final fracture, however, passed through the keyway, as is clearly disclosed from Figs. 10 and 11, which show the two fractured surfaces, male and female. There may be some question as to whether the cause of the crack was the rough filing of the rod or stress-corrosion. It would appear, however, to be a combination of both of these causes, the file marks aiding the stress-corrosion and concentrating the stresses. Had the finish been smooth and the taper fit correct, the fracture would not have taken place where it did, but farther from the end of the keyway, as in those fractures which were considered in the preceding article of this series in the January, 1937, number. It is worthy of comment, also, that the keyway in question has sharp edges.

Another break in the taper fit of a piston rod is shown in Figs. 12 and 13. Here, again, the surface was filed and the failures can be attributed to a possible combination of fatigue cracks starting in the file marks, and stress-corrosion. This fracture is noteworthy because of the well-developed fatigue crack, the beginnings of which could readily be checked with markings on the finished surface.

Another pronounced case of tool marks which eventually caused the failure of a piston rod in the taper fit is illustrated in Figs. 14 and 15. Here we have the frilled fractured end, indicating that fatigue cracks started in several planes and then joined up as the fractures progressed. In order to give some idea of the way in which the break follows the tool marks on a badly finished piston rod, a greatly enlarged view of the broken end of a rod is shown in Fig. 16.

Fig. 5—Fractured end of a piston rod through the taper fit. Fatigue crack started on the poorly finished surface. The section through the keyway indicates the rough finish of the drilled hole. Fig. 6—Side view of a broken piston rod, fracture of which is shown in Fig. 5. Figs. 7 and 8—Cracks which were started on both sides of the taper fit of a piston rod are shown between the daubs of paint. Note the corrosion band near the larger end of the taper. Figs. 9, 10 and 11—A piston rod broken through the taper fit because of rough filing and stress corrosion. Figs. 10 and 11 show the two fractured surfaces. Fig. 12—Fractured surface of broken piston rod shown in Fig. 13.

Just how far should we carry this campaign against tool marks? It can hardly be said that the entire absence of tool marks would eliminate failures, for it must be recognized that there is a certain amount of work-hardening of the surface, due to its machining. The elimination of the tool marks, however, would undoubtedly insure much longer service. The smoother the surface and the less work-hardening we have in machining the rod, the better. We have a long way to go, however, before we can secure the sort of finishes that are desirable and until we can get the thorough co-operation of all of the mechanics involved. This is a matter of education.

As an example, I reported that a certain job was being done too roughly and that tool marks were quite evident. As a result, the machinist reduced the feed from 70 to 140 per inch. An examination of the finished surface showed that a sharp pointed tool had been used, leaving well-defined tool marks. On the other hand, if the machinist had ground the tool properly and increased the feed to 25 per inch, he would have gotten a much better finished surface. The point is that proper consideration must be given to the grinding of the tool and setting it at the right angles for the grade of steel upon which it is being used.

As an appreciation of the importance of a proper finish

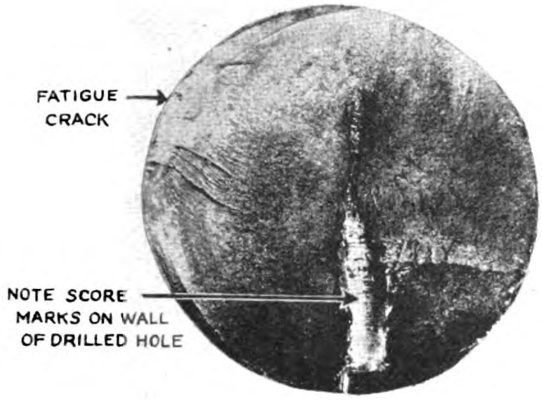


FIG. 5

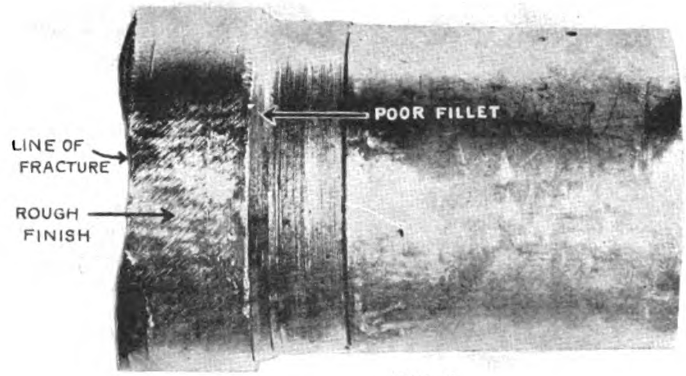


FIG. 6

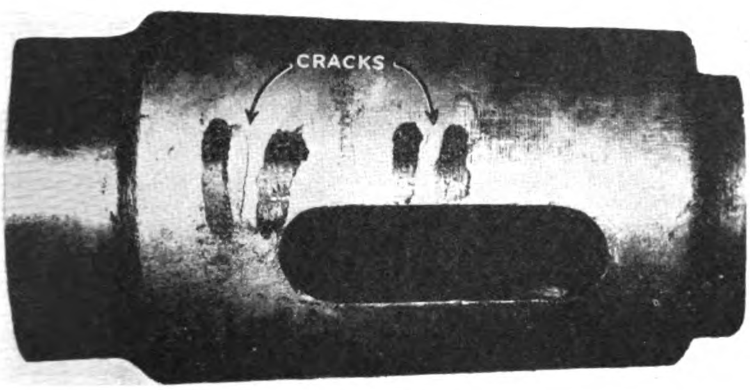


FIG. 7

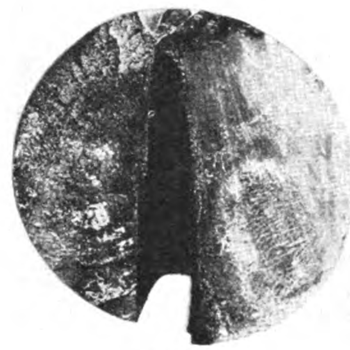


FIG. 10

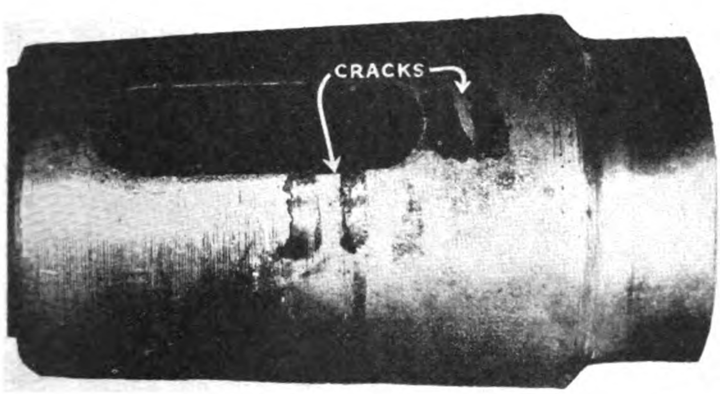


FIG. 8

FIG. 11

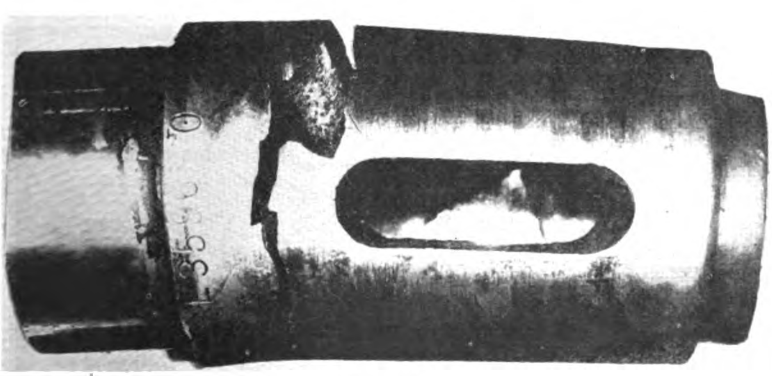


FIG. 9

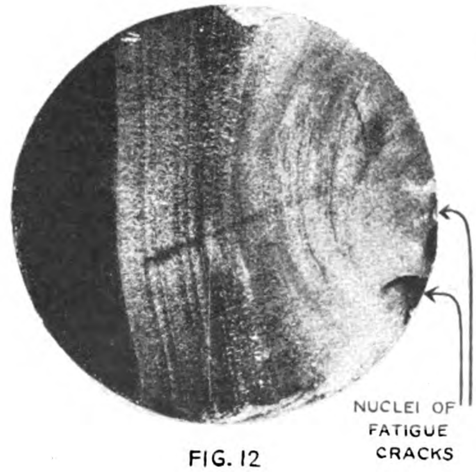


FIG. 12

becomes more general, we find that the average life of piston rods is being lengthened.

Many incidents could be cited indicating that many machinists and shop foremen do not have as full an appreciation as they should of properly machined surfaces.

In the previous article I stressed the importance of undercutting on the taper fit, in order to lengthen the the roughing cuts can sometimes be seen in the finished surface.

While it may seem a paradox, increased production results from good finishes, although not quite in the terms in which we ordinarily think of it in shop practice. The point is that if the job is rightly done in the first place, the part will remain in service much longer than

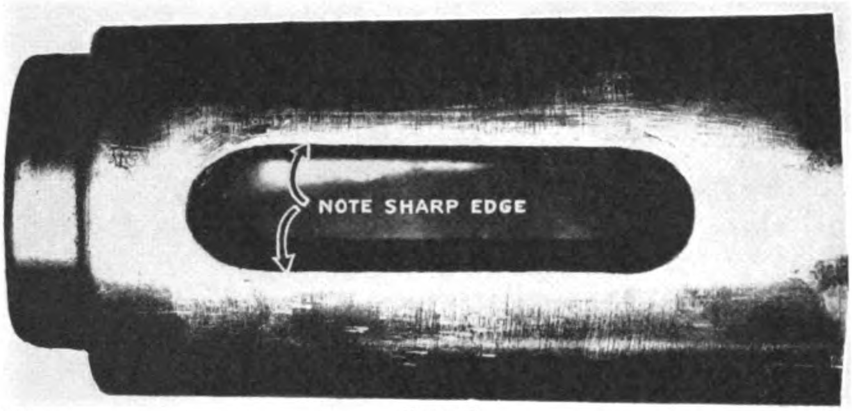


FIG. 13

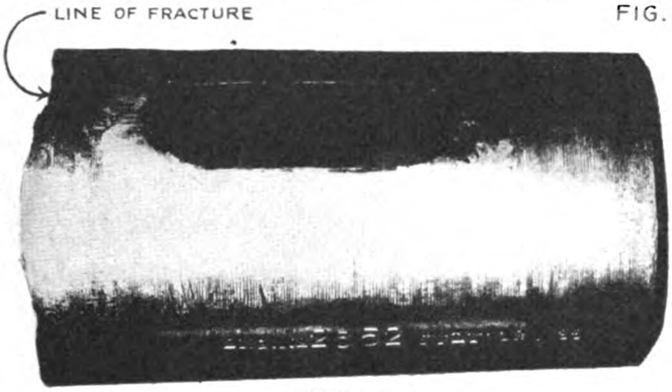


FIG. 15

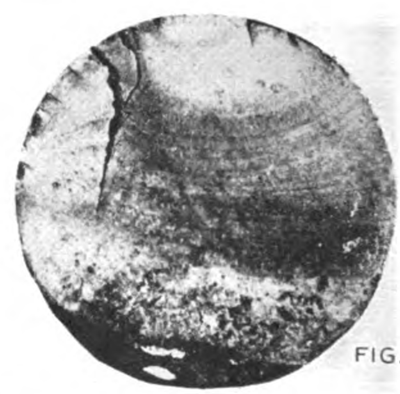


FIG. 14

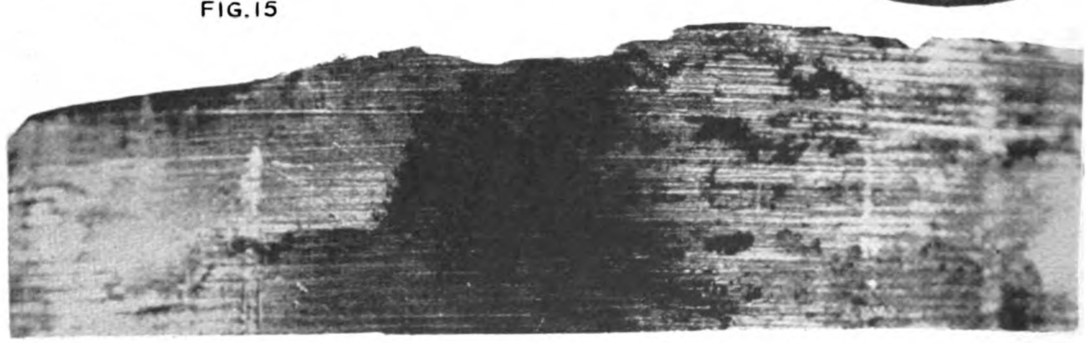


FIG. 16

Fig. 13—Piston rod broken through taper fit; apparently caused by a combination of file marks on the finished surface of the taper fit and stress-corrosion. Figs. 14 and 15—Fractured piston rod in which fatigue cracks started from several tool marks, finally joining as the break progressed. Fig. 16—An enlarged view of a broken piston rod, showing how the cracks progressed along the line of the tool marks

life of the rod. It must be emphasized, however, that the finish of such undercutting must be of the best and that it is worse than useless if it does not have a properly polished finish with smooth fillets of the proper radii.

In making the finishing cut on the taper fit of a piston rod it is necessary to have a proper groundwork or foundation. In other words, the roughing cut must not have badly torn surfaces and must not be too coarse. The importance of this is indicated by the fact that evidence of otherwise. In the long run, therefore, the total amount of work required for a given part is greatly reduced.

It may be difficult to realize, but the fatigue cracks do start from very small and apparently insignificant beginnings. It is said, for instance, that merely touching the surface of a polished test piece with your finger will change the result of the test. How much sooner, then, will a surface badly scored by a tool or file fail to give the service that was intended by the designer?

Summary Tables of

Diesel Motive Power

On this and the three following pages the *Railway Mechanical Engineer* is presenting, for the first time, a tabulation of the characteristics of the Diesel engines designed for railroad service which are manufactured in the United States, as well as summary tables of the Diesel-powered locomotives, rail cars and streamlined trains in service at the end of the year 1936. The so-called power cars of high-speed light-weight trains, where the body units are devoted exclusively to power plants or auxiliaries and are not permanently connected to the train by articulation are considered to be locomotives and are so listed.

For the sake of consistency present names of engines and engine builders have been used throughout these tables irrespective of the dates on which the engines were installed.

Characteristics of Railroad-Type Diesel Engines

Name of Builder—American Locomotive Company, Diesel Engine Division
General Offices, 30 Church St., New York City. Plant Location, Auburn, N. Y.

Horse-power	Two or four cycle	Cylinders No.	Cylinders Arrgt.	Cylinders Bore and stroke—in.	r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injec-tion system
300	4	6	Line	9½ x 10½	700	1,225	76	15,000	50	None	C
400	4	6	Line	9½ x 10½	875	1,530	81	15,500	38.8	None	C
600	4	6	Line	12½ x 13	700	1,517	71	35,000	58.4	None	C
660[1]	4	6	Line	12½ x 13	740	1,600	73	27,000	41.0	None	C
900	4	6	Line	12½ x 13	700	1,517	105	38,000	42.2	Supercharged	C
900[1]	4	6	Line	12½ x 13	700	1,517	105	30,000	33.3	Supercharged	C

[1] For rail car service.

Name of Builder—Busch-Sulzer Bros.—Diesel Engine Company
General Offices, St. Louis, Mo. Plant Location, St. Louis, Mo.

Horse-power	Two or four cycle	Cylinders No.	Cylinders Arrgt.	Cylinders Bore and stroke—in.	r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injec-tion system
1,600	2	8	V	13½ x 16	550	1,430	63.0	39,000 Approx.	25	Cross	C
2,000	2	10	V	14 x 16	550	1,430	58.5	72,000	36	Cross-Roots blower	C

Name of Builder—Cooper-Bessemer Corporation
General Offices, Mt. Vernon, Ohio. Plant Location, Mt. Vernon, Ohio.

Horse-power	Two or four cycle	Cylinders No.	Cylinders Arrgt.	Cylinders Bore and stroke—in.	r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injec-tion system
250	4	6	Line	8 by 10½	750	1312	85.0	9,800	39.2	None	B[2]
335	4	8	Line	8 by 10½	750	1312	85.0	12,500	37.3	None	B[2]
500	4	6	Line	10½ x 12	750	1500	85.0	21,000	42.0	None	B[2]
660	4	8	Line	10½ x 12	750	1500	85.0	26,000	39.4	None	B[2]

[2] Modified distributor system.

Name of Builder—Cummins Engine Company
General Offices, Columbus, Ind. Plant Location, Columbus, Ind.

Horse-power	Two or four cycle	Cylinders No.	Cylinders Arrgt.	Cylinders Bore and stroke—in.	r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injec-tion system
100	4	4	Line	4⅞ x 6	1,800	1,800	97.0	1,640	16.4	None	B
125	4	3	Line	7 x 10	1,000	1,670	85.4	4,645	37.1	None	B
140	4	4	Line	6¾ x 9	1,000	1,500	86.3	5,400	38.5	None	B
150	4	6	Line	4⅞ x 6	1,800	1,800	97.0	2,120	14.1	None	B
154	4	4	Line	7 x 9	1,000	1,500	87.8	5,400	35.1	None	B
165	4	4	Line	7 x 10	1,000	1,670	85.4	5,400	32.4	None	B
210	4	6	Line	6¾ x 9	1,000	1,500	86.3	7,075	33.7	None	B
230	4	6	Line	7 x 9	1,000	1,500	87.8	7,075	30.8	None	B
250	4	6	Line	7 x 10	1,000	1,670	85.4	7,075	28.3	None	B
350	4	6	Line	10 x 12	500	1,000	76.0	12,040	40.2	None	B

Name of Builder—De La Vergne Engine Co.
General Offices, Philadelphia, Pa. Plant Location, Eddystone, Pa.

Horse-power	Two or four cycle	Cylinders			r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injec-tion system
		No.	Arrgt.	Bore and stroke—in.							
660	4	6	Line	12½ x 15½	600	1,550	76.3	20,600[3]	31.2	None	C

[3]Includes oil pan, air and exhaust headers but no fly-wheel.

Name of Builder—Electro-Motive Corporation (Subsidiary of General Motors)
General Offices, La Grange, Ill. Plant Location, La Grange, Ill.

Horse-power	Two or four cycle	Cylinders			r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injec-tion system
		No.	Arrgt.	Bore and stroke—in.							
600	2	8	Line	8 x 10	750	1,250	79.0	13,150	21.9	Through-Roots blower	D
900	2	12	V	8 x 10	750	1,250	79.0	17,900	20.0	Through-Roots blower	D
1,200	2	16	V	8 x 10	750	1,250	79.0	21,550	18.0	Through-Roots blower	D

Name of Builder—Fairbanks-Morse & Co.
General Offices, 900 South Wabash Ave., Chicago. Plant Location, Beloit, Wis.

Horse-power	Two or four cycle	Cylinders			r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injec-tion system
		No.	Arrgt.	Bore and stroke—in.							
120	4	6	Line	5½ x 7½	1,200	1,500	74.1	4,424	36.8	None	C
160	4	8	Line	5½ x 7½	1,200	1,500	74.1	5,689	35.5	None	C
300	2	6[4]	Line	5 x 6	1,200	1,200	70.0	9,300	31.0	Cross-through blower	C
400	2	8[4]	Line	5 x 6	1,200	1,200	70.0	10,500	26.3	Cross-through blower	C
750	2	5[4]	Line	8 x 10	720	1,200	82.2	18,850	25.1	Cross-through blower	C
900	2	6[4]	Line	8 x 10	720	1,200	82.2	21,200	23.6	Cross-through blower	C
1,200	2	8[4]	Line	8 x 10	720	1,200	82.2	25,900	21.6	Cross-through blower	C

[4]Opposed piston engine.

Name of Builder—Ingersoll-Rand Co.
General Offices, 11 Broadway, New York, N. Y. Plant Location, Phillipsburg, N. J.

Horse-power	Two or four cycle	Cylinders			r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injec-tion system
		No.	Arrgt.	Bore and stroke—in.							
300	4	6	Line	10 x 12	550	1,100	76.0	19,500	65.0	None	C
430	4	6	Line	10 x 12	750	1,500	80.2	16,500	38.4	None	C
575	4	8	Line	10 x 12	750	1,500	80.5	22,000	38.2	None	C
900	4	6	Line	14¾ x 16	550	1,470	79.0	38,500	38.9	None	C

Name of Builder—Westinghouse Electric & Manufacturing Company
General Offices, Philadelphia, Pa. Plant Location, S. Philadelphia (Lester), Pa.

Horse-power	Two or four cycle	Cylinders			r.p.m.	Piston speed—f.p.m.	Mean eff. press. lb. per sq. in.	Engine weight—lb.	Wt. per hp.—lb.	Scaveng-ing system	Injec-tion system
		No.	Arrgt.	Bore and stroke—in.							
265	4	4	Line	9 x 12	900	1,800	76.5	10,255[5]	38.7	None	C
400	4	6	Line	9 x 12	900	1,800	76.5	12,220[5]	30.5	None	C
530	4	6	Line	9 x 12	900	1,800	102.0	14,600[5,6]	27.6	See note [7]	C
800	4	12	V	9 x 12	900	1,800	76.5	24,800[5]	31.0	None	C
1,060	4	12	V	9 x 12	900	1,800	102.0	27,000[5,6]	25.5	See note [7]	C

[5]Includes flywheel, bedplate, muffler, intake strainers.
[6]Includes air intake silencers.
[7]Supercharged by Roots blower.

Injection systems:
- A—Common rail
- B—Distributor
- C—Individual fuel pump
- D—Unit injector

Diesel-Electric Locomotives in the United States and Canada

Railroad	No. of units	Wheel arrgt.	Service	Name of builder of: Locomotive	Engine	Elec. equip.	Engines: No.	h.p. each	Total weight lb.	Date in service
A. T. & S. F.	1	0-4-4-0	Pass.	Electro-Motive St. Louis Car	E. M. C.	Gen. Elec.	2	900	258,400	1935
	1	0-4-4-0	Pass.	Electro-Motive St. Louis Car	E. M. C.	Gen. Elec.	2	900	258,400	1935
	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	203,000	1935
	1	0-4-4-0	Switch.	Electro-Motive	E. M. C.	Gen. Elec.	1	600	194,700	1936
B. & O.	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	120,000	1925
	1	0-4-4-0	Pass.	Electro-Motive & Gen. Elec.	E. M. C.	Gen. Elec.	2	900	259,000	1935
Belt Ry. of Chicago	1	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	2	300	216,000	1934
	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	203,000	1934
	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	203,000	1935
	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	199,000	1935
Boston & Maine	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	197,500	1934
	1	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	2	300	208,672	1934
	3	0-4-4-0	Switch.	Electro-Motive	E. M. C.	Gen. Elec.	1	600	197,580	1936
(Portland Term.)	3	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	196,000	1936
Bush Terminal	7	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	1	300	117,000	1931
Canadian National	2	4-8-4	Pass.	Can. Loco. Wks.	Beardmore	West.	1	1,330	334,000	1929
	1	0-4-4-0	Switch.	Can. Loco. Wks.	West.	West.	1	400	140,000	1930
	1	0-4-4-0	Switch.	R. R. Co.	Ing.-Rand	Gen. Elec.	2	300	234,000	1932
Central Railroad of New Jersey	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	120,000	1925
Cheswick & Harmer	1	0-4-4-0	Switch.	Baldwin	West.	West.	2	265	130,000	1933
Chicago & North Western	2	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	130,000	1926
	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	130,000	1927
	1	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	2	300	216,000	1930
Chicago, Burlington & Quincy	3	0-4-4-0	Switch.	Midwest	Cummins	Gen. Elec.	2	250	130,000	1933-34
	2	[1]	Pass.	Electro-Motive	E. M. C.	Gen. Elec.	2 / 1	900 / 1200	426,000	1936
	2	0-4-4-0	Pass.	Electro-Motive	E. M. C.	Gen. Elec.	2	900	222,520	1936
Chicago Great Western	1	0-4-4-0	Switch.	Baldwin	West.	West.	1	800	228,400	1934
	2	0-4-4-0	Switch.	Bethlehem	West.	West.	2	400	230,000	1936
	3	0-4-4-0	Switch.	Electro-Motive	E. M. C.	Gen. Elec.	1	600	200,000	1936
Chicago, Rock Island & Pacific	1	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	1	300	256,000	1930[4]
Delaware, Lackawanna & Western	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	132,700	1926
	2	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	1	300	248,000	1930[2]
	2	0-4-4-0	Switch.	Gen. Elec.	E. M. C.	Gen. Elec.	1	600	204,150	1935
	8	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	204,000	1933-34
	6	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	2	300	204,000	1933-34
Erie	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	130,000	1926
	2	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	2	300	233,000	1927
	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	130,000	1928
	1	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	1	800	230,000	1931
Great Northern	1	0-4-4-0	Mixed	Alco	Ing.-Rand	Gen. Elec.	2	300	209,500	1926
Harlem Transfer (N. Y. City)	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	132,700	1926
Hoboken Manufacturer's Railroad	1	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	1	300	144,000	1928
	1	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	2	300	220,000	1928
Illinois Central	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	2	300	215,650	1929
	5	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	2	300	215,650	1930
	8	0-4-4-0	Switch.	Alco	Alco	West.	1	600	198,000	1934
	1	0-6-6-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	2	900	342,000	1936
	1	0-6-6-0	Switch.	Gen. Elec.	Busch-Sulzer	Gen. Elec.	1	2,000	346,000	1936
	1	4-4-4-4	Switch.	St. Louis Car	E. M. C.	Gen. Elec.	2	900	324,000	1936
Jay St. Terminal (N. Y. City)	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	300	120,000	1931
Lehigh Valley	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	123,000	1926
	1	0-4-4-0	Switch.	Brill	Alco	Gen. Elec.	1	300	142,500	1927
	2	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	300	132,000	1931
	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	202,000	1932
	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	127,580	1932
Long Island	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	2	300	203,300	1925
	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	2	300	218,000	1928
	1	0-4-4-0	Switch.	Baldwin	West.	West.	2	300	174,000	1928
Midland Continental	1	0-4-4-0	Road	Baldwin	West.	West.	2	265	144,000	1934
Missouri Southern	1	0-4-4-0	Switch. and local freight	Plymouth	Cummins	West.	2	250	130,000	1934
New York Central System	1	4-8-4	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	750	300,000	1928
	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	257,000	1928[3]
	37	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	1	300	256,000	1930[3]
	4	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	1	300	256,000	1930[3]
	1	0-4-4-0	Switch.	Gen. Elec.	Buda	Gen. Elec.	1	90	90,000	1933[4]
	7	0-4-4-0	Switch.	Electro-Motive	E. M. C.	Gen. Elec.	1	600	200,000	1936
New York, New Haven & Hartford	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	200,000	1932
	5	0-4-4-0	Switch.	Gen. Elec.	Ing.-Rand	Gen. Elec.	1	600	195,000	1936
	5	0-4-4-0	Switch.	Gen. Elec.	Cooper-Bessemer	Gen. Elec.	1	660	196,000	1936
Northampton & Bath	1	0-4-4-0	Switch. and terminal	Baldwin	West.	West.	2	400	220,000	1932
	1	0-4-4-0	Switch. and terminal	Baldwin	West.	West.	2	400	220,000	1934
Peoria & Pekin Union	1	0-4-4-0	Switch.	Alco	Alco	Gen. Elec.	1	600	199,000	1936
Phila. Beth. and N. E.	1	0-4-4-0	Switch.	Bethlehem	E. M. C.	West	1	900	204,000	1935
	1	0-4-4-0	Switch.	Gen. Elec.	Buda	West	1	150	130,000	1933[4]
Reading	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	130,000	1926
	1	0-4-4-0	Switch.	Alco	Ing.-Rand	Gen. Elec.	1	300	133,900	1928
South Buffalo Ry.	2	0-4-4-0	Switch.	Electro-Motive	E. M. C.	Gen. Elec.	1	600	200,000	1936
Union Pacific	1[1]	[1]	Pass.	Pull.-Std.	E.M.C.	Gen. Elec.	1 / 1	900 / 1,200	334,440	1936
	1[1]	[1]	Pass.	Pull.-Std.	E. M. C.	Gen. Elec.	2	1,200	391,390	1936
	2[1]	[1]	Pass.	Pull.-Std.	E. M. C.	Gen. Elec.	2	1,200	390,050	1936
	1[1]	[1]	Pass.	Pull.-Std.	E. M. C.	Gen. Elec.	2	1,200	430,000	1936

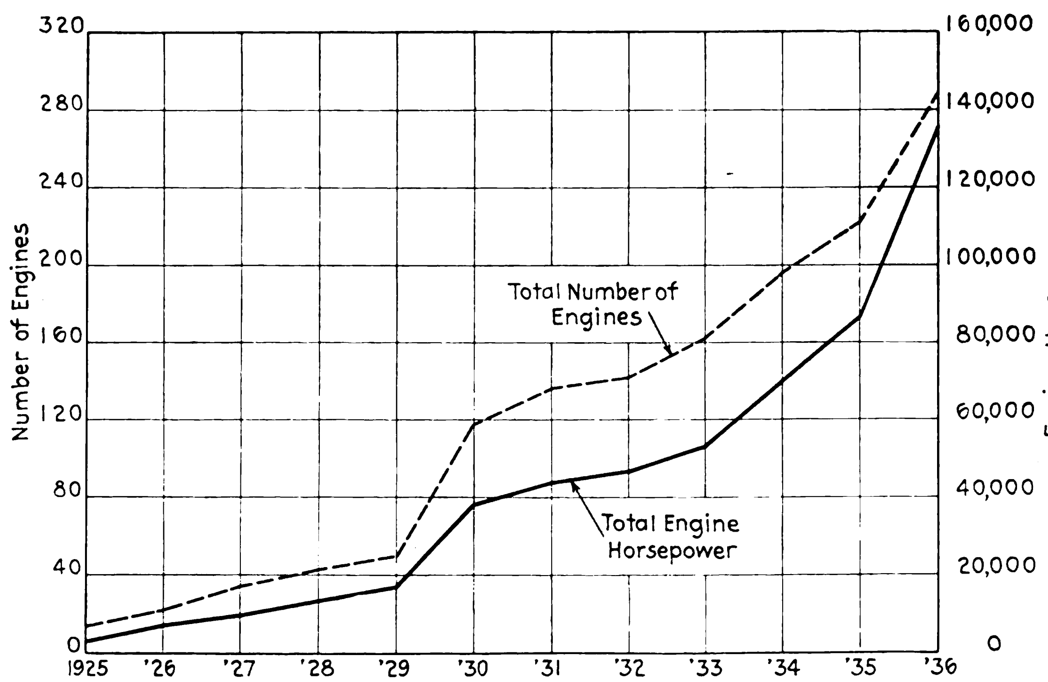
Notes:
[1] Two unit locomotive, each unit having two four-wheel trucks.
[2] Oil-electric battery 3,000-volt trolley.
[3] Oil-electric-battery 600-volt third rail.
[4] Oil-electric-battery.

Diesel-Electric Rail Cars and Trains in the U. S. and Canada

Railroad	Year ordered	Name of train	No. of cars	No. of trains	No. of body units each train	Builder of— Train or car	Builder of— Engine	Elec. equip.	Engines— No.	Engines— Hp. each	Total weight, lb.
Boston & Maine	1934	Flying Yankee	..	1	3 artic.	Budd	E.-M. C.	Gen. Elec.	1	600	218,917
	1934	....	1	..	....	St. Louis Car	Ing.-Rand	Gen. Elec.	2	400	221,000
	1934	....	1	..	....	St. Louis Car	West.	West.	1	950	221,700
Maine Central	1935	....	1	..	....	St. Louis Car	Ing.-Rand	Gen. Elec.	2	300	218,000
Canadian National	1924	....	7	..	....	Ottawa Car Co. R. R. Co.	Beardmore	English Elec.	1	200	102,000
	1924	....	..	1	2 artic.	Ottawa Car Co. R. R. Co.	Beardmore	West.	1	400	188,000
	1926	....	5	..	....	C. C. & F. R. R. Co.	Beardmore	West.	1	300	141,000
	1928	....	1	..	....	Nat'l. Steel	Beardmore	English Elec.	1	200	100,000
	1929	....	7	..	....	C. C. & F.	West.	West.	1	350	142,000
	1930	....	2	..	....	Nat'l. Steel	West.	West.	1	350	144,000
	1930	....	4	..	....	Nat'l. Steel R. R. Co.	Beardmore	West.	1	300	141,000
Chicago, Burlington & Quincy	1933	Zephyr	..	1	4 artic.[1]	Budd	E.-M. C.	Gen. Elec.	1	600	266,000[1]
	1934	Twin Zephyrs	..	2	3 artic.	Budd	E.-M. C.	Gen. Elec.	1	600	225,000
	1935	Mark Twain Zephyr	..	1	4 artic.	Budd	E.-M. C.	Gen. Elec.	1	600	290,000
Erie	1929	....	1	..	....	St. Louis Car	West.	West.	2	300	206,808
Great Northern	1930	....	1	..	....	St. Louis Car	West.	West.	1	400	147,780
	1933	....	1	..	....	Std. Steel	West.	West.	1	400	161,700
Gulf, Mobile & Northern	1934	Rebel	..	2	3 non-artic. (including power unit)[2]	A. C. F.	Alco	West.	1	660	373,200[2]
Illinois Central	1934	Green Diamond	..	1	5 artic.	Pull.-Std.	E.-M. C.	Gen. Elec.	1	1,200	543,400
New York, New Haven & Hartford	1934	Comet	..	1	3 artic.	Good.-Zepp.	West.	West.	2	400	260,590
Pennsylvania	1928	....	2	..	....	Pull.-Std.	West.	West.	1	330	133,475
Reading	1929	....	1	..	....	Bethlehem	West.	West.	1	300	138,400
	1929	....	1	..	....	Bethlehem	West.	West.	1	300	137,300
	1932	....	1	..	....	Budd	Cummins	West.	1	125	23,400
Seaboard Air Line	1935	....	2	..	....	St. Louis Car	E.-M. C.	Gen. Elec.	1	600	156,126
	Note[3]	....	2	..	....	A. C. F.-Brill	West.	West.	1	265	128,050
	Note[3]	....	1	..	....	A. C. F.-Brill	West.	West.	1	265	117,000
Union Pacific	1933	City of Portland	..	1	7 artic.[4]	Pull.-Std.	E.-M. C.	Gen. Elec.	1	900	592,000[5]

[1] Four body units. Originally built as three body units weighing 219,000 lb.
[2] A seventh car provided for interchangeable service. Weight includes power car and two trailers.
[3] Cars originally built in 1927 as gas-electric; Diesel engines installed in 1936.
[4] Originally six body units; one added, June, 1935.
[5] Weight of seven-car train.

Diesel Engines in Locomotives, Rail Cars and Streamline Trains in the U. S. and Canada



First Sizable

Equipment Market Since 1930

Locomotive and freight-car orders in 1936 were the largest since 1929, although passenger-car orders during the past year were exceeded in 1934 and 1930. Light-weight high-speed trains were an important factor in last year's business

ORDERS for motive power and rolling stock placed in the United States during 1936 showed a big increase over those placed during the preceding year. The 533 locomotives constitute the largest number of orders placed since 1929 when 1,212 were ordered in the United States. The orders for 67,544 freight cars have not been exceeded since 1930 and are nearly 17 per cent more than total number ordered during the preceding five years. In the case of passenger cars, although the 307 ordered in 1936 marked a big increase over 1935, they did not equal the number ordered in 1934 or in 1930.

Table I — Orders for Locomotives of All Types Since 1918

Year	Domestic	Canadian	U. S. Export	Total
1918	2,593	209	2,086	4,888
1919	214	58	898	1,170
1920	1,998	189	718	2,905
1921	239	35	546	820
1922	2,600	68	131	2,799
1923	1,944	82	116	2,142
1924	1,413	71	142	1,626
1925	1,055	10	209	1,274
1926	1,301	61	180	1,542
1927	734	58	54	846
1928	603	98	27	728
1929	1,212	77	106	1,395
1930	440	95	20	555
1931	176	2	28	206
1932	12	1 (Export)	1	14
1933	42	...	7	49
1934	182	...	17	199
1935	83	27	15	125
1936	533	1	22	556

Unlike the situation in the United States the Canadian orders were relatively small. Only one locomotive was ordered for service in Canada. The 271 freight cars ordered for service in Canada compare with 2,421 for which orders were placed in 1935, and the 10 passenger-car orders were also exceeded by the 16 during the preceding year.

Locomotive Orders

In Table II is shown a classification, by types, of the locomotives ordered during 1936. Of the 498 locomotives ordered for railway service, 110 are of the 4-8-4 type, 66 of the 4-6-4 type, 62 of the 0-8-0 type, and 61 Diesel-electric locomotives. This indicates clearly the increase in the demand for the 4-8-4 type for high-capacity passenger service and fast freight service. The table also brings out clearly the renewed popularity of the articulated types to meet the demand for expedited schedules in freight service over difficult lines. Orders for a total of 97 articulated locomotives, with five types of wheel arrangement, were placed last year. These are all single-expansion locomotives.

Table II — Types and Number of Steam Locomotives Ordered in 1936

Type	Railroad U. S. and Canada	Industrial service	Export	Total
0-4-0	...	2	1	3
0-6-0	7	5	..	12
0-8-0	62	..	..	62
0-10-2	9	..	..	9
2-8-0	...	..	5	5
2-8-2	13	..	5	18
2-10-2	...	..	1	1
2-8-4	10	..	..	10
2-10-4	40	..	..	40
4-4-2	2	..	..	2
4-6-2	5	1	3	9
4-6-4	66	..	..	66
4-8-2	5	..	..	5
4-8-4	110	..	..	110
2-6-6-2	...	..	2	2
2-6-6-4	17	..	..	17
2-8-8-2	9	..	..	9
4-4-4-4	1	..	..	1
4-6-6-4	44	..	..	44
4-8-8-2	26	..	..	26
Electric	10	14	5	29
Diesel-elec.	61	14	..	75
Steam turbo-elec.	1	..	..	1
Total	498	36	22	556

Among the large orders placed during the year were 50 4-6-4 type for the New York Central and 50 0-8-0 type for the Pittsburgh & Lake Erie. The Chicago, Milwaukee, St. Paul and Pacific ordered 30 4-8-4 type locomotives for freight service, and the Union Pacific 20 4-8-4 type locomotives for passenger service. Numerous orders for 10 or more locomotives of a single type were also placed by other railroads.

Of the 61 Diesel-electric locomotives for which orders were placed during the year 15 were for road passenger service, six of 1,200 hp. capacity, three of 3,600 hp., two of 5,400 hp., two of 3,000 hp., and two of 1,800 hp. The others are from 600 to 1,000 hp. capacity. A number of smaller capacity locomotives were ordered for industrial service. Among these were several gas-electric, one gasoline and one propane-electric locomotive. With the exception of one electric locomotive for freight service, ordered by the Pennsylvania, the electric locomotives were ordered for industrial or terminal service.

Table III — Orders for Freight Cars Since 1918

Year	Domestic	Canadian	Export	Total
1918	114,113	9,657	53,547	177,317
1919	22,062	3,837	3,994	29,893
1920	84,207	12,406	9,056	105,669
1921	23,346	30	4,982	28,358
1922	180,154	746	1,072	181,972
1923	94,471	8,685	396	103,552
1924	143,728	1,867	4,017	149,612
1925	92,816	642	2,138	95,596
1926	67,029	1,495	1,971	70,495
1927	72,006	2,133	646	74,785
1928	51,200	8,901	2,530	62,631
1929	111,218	9,899	3,023	124,140
1930	46,360	1,936	1,200	49,496
1931	10,880	3,807	151	14,838
1932	1,968	501	77	2,546
1933	1,685	75	132	1,892
1934	24,611	12	1,323	25,946
1935	18,699	2,421	110	21,230
1936	67,544	271	526	68,341

Freight-Car Orders

The number of freight cars ordered annually since 1918 is shown in Table III. Of the total of 68,341 cars ordered in the United States and Canada, 67,544 were

Table IV — Class and Number of Freight Cars Ordered in 1936

Class	United States and Canada Railroads	Private	Total	Export
F—Flat	1,224	15	1,239	..
G—Gondola	10,039	475	10,514	..
H—Hopper	18,348	179	18,527	..
HR—Covered hopper	11	50	61	..
R—Refrigerator	1,000	6,397	7,397	..
T—Tank	2	4,010	4,012	16
X—Box	18,367	..	18,367	500
XA—Auto. box	4,695	..	4,695	..
S—Stock	400	..	400	..
N—Caboose	123	..	123	..
Not classified	2,430	50	2,480	10
Total	56,639	11,176	67,815	526

for service in the United States. This may again be subdivided into 56,639 ordered by railroads and 11,176 ordered by private car lines or other non-carrier owners. Almost equal numbers of hopper and box cars were ordered, and these two classes combined constitute approximately 65 per cent of the total number of cars ordered by the railroads. Only two of the 4,012 tank cars ordered during the year were on railroad account, while 1,000 refrigerator cars were ordered by railroads and 6,397 by private car lines.

Among the large orders for freight cars were those placed by the Chesapeake & Ohio for 7,350, of which 4,000 are hoppers; the Norfolk & Western for 6,100, of which 4,500 are hoppers; the Southern Pacific for 4,975, of which 1,750 are double-sheathed box cars; the Chicago, Burlington & Quincy for 4,800, and the Atchison, Topeka & Santa Fe for 3,585. Of the 67,544 cars ordered for domestic service in the United States, 14,290 —about 21 per cent—were placed with company shops by 27 railroads or private car lines. Included are private car lines who regularly build part or all of their own equipment.

Table V — Orders for Passenger Train Cars Since 1918

Year	Domestic	Canadian	Export	Total
1918	9	22	26	57
1919	292	347	143	782
1920	1,781	275	38	2,094
1921	246	91	155	492
1922	2,382	87	19	2,488
1923	2,214	263	6	2,483
1924	2,554	100	25	2,679
1925	2,191	50	76	2,317
1926	1,868	236	58	2,162
1927	1,612	143	48	1,803
1928	1,930	334	29	2,293
1929	2,303	122	33	2,458
1930	667	203	15	885
1931	11	11	21	43
1932	39	..	..	39
1933	6	..	..	6
1934	388	..	15	403
1935	63	16	..	79
1936	*307	10	..	*317

* Includes 102 body units of articulated or partially articulated trains.

Passenger-Car Orders

While the 307 passenger cars ordered during 1936 was more than three times the number placed during the preceding year, it was still less than the number ordered in 1934. Included in the 307 cars are 102 body units of articulated or partially articulated trains. The largest orders were placed by the New York, New Haven & Hartford and the Union Pacific, each constituting 50 units; those of the New Haven all were coaches while the Union Pacific order was for 40 coaches and five articulated diners consisting of five dining-room body units and five kitchen body units. The latter road also shared in the order for two 14-car trains of partially articulated equipment with the Southern Pacific and the Chicago & North Western.

The order placed with its own shop for 37 passenger cars, constituting coaches, mail, express, parlor, dining and tap-room equipment, also numbers the Chicago Milwaukee, St. Paul & Pacific among the roads placing outstanding orders during the year.

Annual Report of the

Bureau of Locomotive Inspection

Twenty-fifth annual report shows an increase in accidents but a decrease in the number of employes killed and injured.

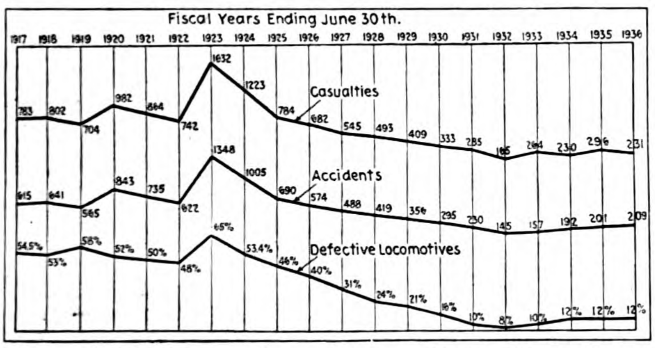
The annual report of John M. Hall, chief inspector, Bureau of Locomotive Inspection, to the Interstate Commerce Commission, marks the completion of a quarter of a century of federal control of locomotive inspection. This twenty-fifth annual report shows the improvement in the condition of steam locomotives and deaths and accidents resulting therefrom since February 11, 1911, when the Locomotive Boiler Inspection Act became obligatory upon the carriers. Although authentic records do not show the number of casualties caused by defective boilers and their appurtenances prior to the passage of the act, the first annual report in 1912 showed that 91 persons were killed and 1,005 were injured in accidents involving locomotive boilers. As a result of federal inspection the number of persons killed and injured were reduced to 10 and 80, respectively, in 1936. In 1917 the act was amended to include the entire locomotive and tender, and was amended later to include all locomotives regardless of the source of power. During the period from 1912 to 1936 there were 717 persons killed and 8,771 injured as a result of failures of locomotive boilers and their appurtenances. It is interesting to note that if the casualties had occurred at the same rate throughout this period as they occurred during the first year in which the act was effective there would have been 2,275 persons killed and 27,125 injured.

Steam Locomotives

The total number of steam locomotives inspected by the bureau during the past fiscal year ending June 30, 1936, was 97,329, of which 11,526 or 12 per cent were found defective. This compares with 11,071 defective locomotives in the year ending June 30, 1935, and 10,713 in 1934. The number of locomotives ordered out of service in 1936, 1935, and 1934 were 852, 921, and 754, respectively, which figures compare with the low of 527 in 1932. The locomotives ordered out of service in 1936 represent a reduction of 7.5 per cent under the number ordered out of service in 1935.

The number of defects found in 1936 totaled 47,453, which compares with 44,491 in 1935 and 43,271 in 1934.

The number of defects in 1936 represents an increase of approximately 7 per cent over 1935. A total of 209 accidents were reported in 1936 as against 201 in 1935, an increase of 4 per cent. However, the number of persons killed fell to 16 in 1936 from 29 in 1935, a decrease of 44.8 per cent, whereas the 29 killed in 1935 was an increase of 21 or 314.3 per cent over 1934. The number of persons injured in 1936 totaled 215, as against 267 in 1935, and 223 in 1934. The 1936 total represents a decrease of 19.5 per cent from the number in 1935. The total of 231 casualties in 1936, when there were 209 accidents, compares with the low of 165 casualties in 1932, when there were 145 accidents. Compared with the first year in which the Boiler Inspection Act was effective, the 1936 report shows a reduction of 96 per cent in the number of accidents, a reduction of 89 per cent in the number



Relation of defective steam locomotives to accidents and casualties resulting from locomotive failures

of persons killed, and a reduction of 92 per cent in the number of persons injured.

During the year 12 per cent of the steam locomotives inspected were found with defects or errors that should have been corrected before the locomotives were placed in service as compared with only 8 per cent in 1932. As noted previously there was an increase of 7.5 per cent in the number of locomotives ordered out of service and an increase of 7 per cent in the number of defects found. A comparison of the number of defects found over a six-year period together with the itemization of these defects is shown in one of the tables.

Boiler Explosion

Boiler explosions caused by crown sheet failures continue to be the source of most of the fatal accidents. There was a decrease of three accidents, a decrease of 13 in the number of persons killed, and a decrease of 52 in the number of persons injured from this cause, as compared with the previous year. Eight persons were killed in such failures; this represents 50 per cent of all fatalities that occurred during the year. Eight persons were injured in accidents caused by crown-sheet failures; this represents 3.7 per cent of all injuries that occurred during the year.

Other boiler and appurtenance accidents, including the failure of a side sheet due to overheating caused by negligence in not washing the boiler as often as water conditions required, resulted in the death of two persons and the injury of 72 persons.

Extension of Time for Removal of Flues

Applications for extensions of time for removal of flues as provided for in Rule 10 totaled 1,115. Of these 92 were rejected, 75 were given extensions for a shorter time than requested, 124 were granted after defects found were repaired, 28 requests were cancelled, and 796 extensions were granted for the full periods requested.

Other Types of Locomotives

In 1936 there were 3,118 locomotives other than steam inspected of which 252, or 8 per cent, were found defective, and 11 ordered out of service. This compares with

Condition of Locomotives Found by Inspection in Relation to Accidents and Casualties*

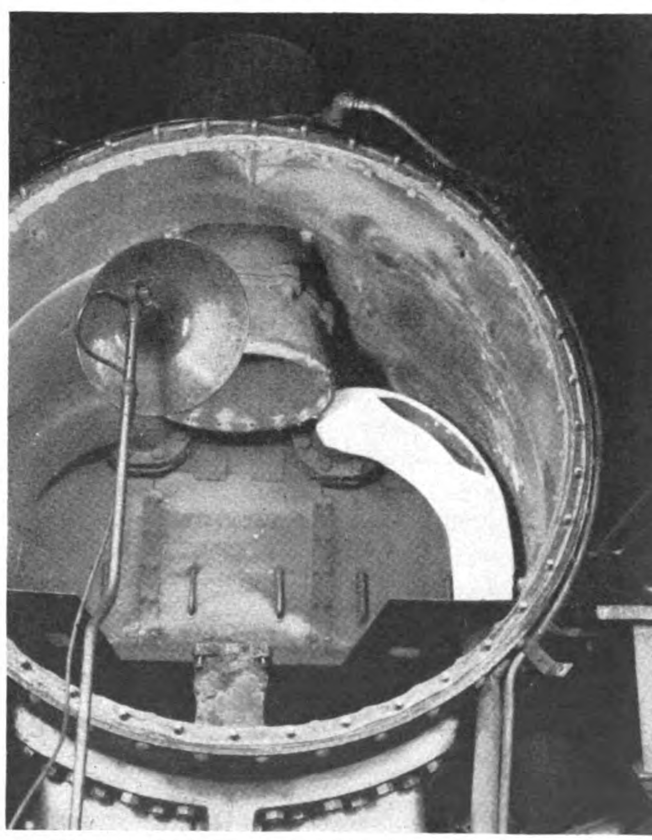
Fiscal year ended June 30	Per cent of locomotives inspected found defective	Number of locomotives ordered out of service	Number of accidents	Number of persons killed	Number of persons injured
1912	65.7	3,377	856	91	1,005
1915	44.4	2,027	425	13	467
1925	46	3,637	690	20	764
1926	40	3,281	574	22	660
1927	31	2,539	488	28	517
1928	24	1,725	419	30	463
1929	21	1,490	356	19	390
1930	16	1,200	295	13	320
1931	10	688	230	16	269
1932	8	527	145	9	156
1933	10	544	157	8	256
1934	12	754	192	7	223
1935	12	921	201	29	267
1936	12	852	209	16	215

* The original act applied only to the locomotive boiler.

1,620 units inspected in 1935 of which 146, or 9 per cent, were found defective and five were ordered out of service. The number of casualties resulting from accidents involving locomotives other than steam was nine in 1936, eight in 1935 and one in 1934. No deaths due to defective equipment have occurred in the past six years.

Changes or modifications in some of the rules for inspection and testing of locomotives other than steam became effective on May 1, 1936. These changes were designed to clarify the applicability of certain rules to the various types of heating equipment involved and to reduce the fire hazard incident to the use of liquid fuels, particularly the fuels used in internal-combustion engines.

Special hazards accompany the use of equipment driven by internal-combustion engines due to the volatil-



Front-end steam pipe that failed while the locomotive was hauling a passenger train at a speed of approximately 45 m.p.h.

ity and inflammability of the liquid fuels. There were eight fires from this case recorded in the past year; four of the fires caused personal injuries, but all may have resulted in major disasters had it not been for fortunate circumstances.

The principal causes of these fires are overflowing through fuel-reservoir vent pipes or carburetors when the reservoirs are being filled due to lack of proper means to indicate the height of fuel in the reservoirs or to inattention on the part of persons performing the filling operation, flooding of carburetors when the engines are in operation, and inability to control the engine speed due to unsuitable throttle mechanism or defective speed governors.

The report states: "If fires are to be avoided, it is incumbent upon the carriers to see that all practical mechanical safeguards are provided and maintained in good operating condition, and that all who are charged with the duty of filling the reservoirs be fully informed as to the proper and safe procedure and the results that may accrue through inattention or carelessness."

Number of Steam Locomotives Reported, Inspected, Found Defective, and Ordered from Service

Parts defective, inoperative or missing or in violation of rules	Year ended June 30— 1936	1935	1934	1933	1932	1931
1. Air compressors	740	733	660	474	417	481
2. Arch tubes	74	74	127	51	54	60
3. Ash pans & mechanism	79	94	87	40	69	81
4. Axles	13	10	6	21	13	10
5. Blow-off cocks	236	283	289	210	144	191
6. Boiler checks	356	413	407	293	214	263
7. Boiler shell	383	395	372	296	220	430
8. Brake equipment	2,480	2,449	2,326	1,696	1,645	1,923
9. Cabs, cab windows and curtains	1,638	1,273	1,342	1,183	851	1,484
10. Cab aprons and decks	450	368	343	309	262	415
11. Cab cards	166	142	129	121	162	211
12. Coupling and uncoupling devices	65	73	54	67	85	98
13. Crossheads, guides, pistons, and piston rods	1,056	1,086	1,100	773	763	856
14. Crown bolts	63	75	77	67	50	96
15. Cylinders, saddles, and steam chests	1,717	1,547	1,491	1,084	841	1,265
16. Cylinder cocks and rigging	605	627	654	374	376	411
17. Domes and dome caps	114	94	105	76	45	83
18. Draft gear	513	423	401	318	325	568
19. Draw gear	451	414	480	357	371	640
20. Driving boxes, shoes, wedges, pedestals, and braces	1,712	1,573	1,472	1,080	821	925
21. Firebox sheets	295	343	356	246	235	341
22. Flues	178	173	203	150	120	187
23. Frames, tailpieces, and braces, locomotive	997	1,006	951	669	611	740
24. Frames, tender	113	124	128	80	86	105
25. Gages and gage fittings, air	257	275	212	145	156	192
26. Gages and gage fittings, steam	350	320	289	258	214	324
27. Gage cocks	579	480	384	388	330	415
28. Grate shakers and fire doors	400	394	404	245	288	410
29. Handholds	502	464	377	363	382	562
30. Injectors, inoperative	40	39	33	20	31	55
31. Injectors and connections	2,085	2,035	1,909	1,357	1,168	1,815
32. Inspections and tests not made as required	9,005	8,344	8,173	6,358	3,801	4,862
33. Lateral motion	404	389	351	269	237	289
34. Lights, cab and classification	78	81	79	76	55	77
35. Lights, headlights	251	257	218	169	119	180
36. Lubricators and shields	255	191	215	157	119	176
37. Mud rings	237	241	247	232	166	318
38. Packing nuts	508	527	491	419	402	523
39. Packing, piston rod and valve stem	1,133	906	833	592	444	706
40. Pilot and pilot beams	178	152	174	123	145	160
41. Plugs and studs	236	167	242	151	176	182
42. Reversing gear	463	414	390	254	202	299
43. Rods, main and side, crank pins, and collars	2,093	1,826	1,670	1,327	1,256	1,520
44. Safety valves	125	100	103	53	63	61
45. Sanders	678	779	697	376	289	314
46. Springs and spring rigging	3,008	2,765	2,854	2,122	1,851	2,161
47. Squirt hose	134	113	107	93	96	184
48. Stay bolts	279	140	285	219	181	293
49. Stay bolts, broken	520	512	455	368	552	938
50. Steam pipes	526	463	489	338	285	512
51. Steam valves	227	212	267	193	143	226
52. Steps	615	640	567	498	622	676
53. Tanks and tank valves	877	913	862	600	587	732
54. Telltale holes	127	102	93	90	108	151
55. Throttles and throttle rigging	760	733	639	448	434	574
56. Trucks, engine and trailing	861	811	898	664	648	714
57. Trucks, tender	1,108	1,120	918	747	766	1,059
58. Valve motion	824	799	784	640	520	497
59. Washout plugs	714	679	776	623	599	815
60. Train-control equipment	6	4	8	4	13	9
61. Water glasses, fittings and shields	1,118	951	907	716	676	955
62. Wheels	790	697	734	580	603	750
63. Miscellaneous — signal appliances, badge plates, brakes (hand)	608	563	572	423	325	418
Total number of defects	47,453	44,491	43,271	32,733	27,832	36,968
Locomotives reported	49,322	51,283	54,283	56,971	59,110	60,841
Locomotives inspected	97,329	94,151	89,716	87,658	96,924	101,224
Locomotives defective	11,526	11,071	10,713	8,388	7,724	10,277
Percentage of inspected found defective	12	12	12	10	8	10
Locomotives ordered out of service	852	921	754	544	527	688

Result of a fire in a rail car

Specification Cards and Alteration Reports

Under rule 54 of the Rules and Instructions for Inspection and Testing of Steam Locomotives, 164 specification cards and 3,732 alteration reports were filed, checked, and analyzed. These reports are necessary in order to determine whether or not the boilers represented were so constructed or repaired as to render safe and proper service and whether the stresses were within the allowed limits. Corrective measures were taken with respect to numerous discrepancies found.

Under rules 328 and 329 of the Rules and Instructions for Inspection and Testing of Locomotives Other Than Steam, 578 specifications and 96 alteration reports were filed for locomotive units and 538 specifications and 182 alteration reports were filed for boilers mounted on locomotives other than steam. These were checked and analyzed and corrective measures taken with respect to discrepancies found. No formal appeal by any carrier was taken from the decisions of any inspector during the year.

EDITORIALS

Photographers, Attention!

We experimented a bit on the Gleanings page in our September, October and November, 1936, numbers, but if the innovation was noted at all it did not bring any reactions to the editorial sanctum. There must be among our readers a considerable number who use the camera discriminately to bring out artistic and unusual subjects and effects. An apprentice on the Northern Pacific, for instance, made a unique night picture of the head end of a passenger train, which we used in September; a "shot" of the Blue Comet, with technical information as to the exposure, appeared in October, and a rather interesting study of a group during the noon hour at the Readville, Mass. (not Conn.), shops of the New Haven, was used on the Gleanings page in November. How about it, photographers? Have you similar studies that you would like to submit for use in our pages?

Apprentices On Tour

"To see at first hand the operations of a number of the most outstanding railway and private industrial enterprises and thus broaden their general knowledge, a group of thirteen railway (Victorian) apprentices left Melbourne last month on a seven-days educational tour of New South Wales."

Thus reads in part an item in "The V.R. (Victorian Railways) News Letter." Victoria and New South Wales are adjacent states in Australia. It would appear that a reciprocal arrangement exists for the interchange of visits of the railway apprentices of these two states, and that in this instance the Victorian apprentices were guests of the New South Wales Railways Department. The students in the group were selected because of the high standard of their work during their two-years apprenticeship. What a wonderful opportunity for these particular young men and for the railroads involved, as well!

The American railways owe much to the old-fashioned boomer mechanic, who, after he became a journeyman, moved about the country from job to job, gathering experience, until he finally settled down, although some of them never could be content to remain too long in one place. With their widely varied experiences they could be depended upon to do most any kind of a job in an emergency, and do it well.

Today, as one of our readers recently pointed out, conditions are such that the boomer mechanic has practically entirely disappeared and the younger mechanics normally have little opportunity to broaden their experience beyond that of the plant in which they serve their time. Something should be done to fill this gap. Visits to other shops (railway and otherwise), attendance at conventions and expositions, special school and technical training during apprenticeship, thorough instruction in shop practices under well qualified teachers—these are some of the measures that may be adopted to give the broader and more comprehensive training which is necessary.

It is high time, is it not, now that the railroads are getting back on their feet, that special attention be given to these matters; otherwise the railroads, and the other industries as well, will suffer greatly in the days to come because of inadequately trained workers.

Replacing Machine Tools In Kind

The statement, made at various times in the past, is now being repeated by those who should know better; namely, that railroads generally have shops full of obsolete machinery and do not realize, or at least admit, the economies which may be effected by replacing these machines with modern tools. It is said that most machine foremen and tool foremen are men of middle age and past who have grown up in their local shops and know little of the productive capacities of machines other than those used on their own railroad. In proof of this assertion, the instance is cited of three worn-out turret lathes recently replaced by three new machines which were, however, definitely specified of a design outmoded over ten years ago.

The only reason for giving space to this account is to deny it as an unjust reflection on railway shops and railway managements. It is not true that railway shops, particularly those being operated today, are full of obsolete machinery and largely officered by men unfamiliar with the possibilities of modern machine practice. Doubtless individual instances may be cited in support of the statement, but, in this case, the exception does not prove the rule, any more than it did when a survey of modern machine tool manufacturers' plants some years ago disclosed the surprising fact that some of their own shop machinery was 40 years old or more.

Of course, the real reason that railway shop machine conditions are no better than they are is that, roughly, 30 per cent of railway mileage is in receivership and it is often exceedingly difficult for local shop superin-

tendents and foremen to get authorization for new maintenance tools which involve a charge to capital expense. To say that they don't know what they need, however, is, in general, manifestly unjust.

With this background statement, the admission may well be made that, in spite of a considerable purchase of railway machine tools last year, and more in prospect for 1937, there are few, if any, shops not handicapped by the presence of some machines which can be replaced, with a saving of at least 30 per cent on the investment. Few shop foremen and tool supervisors are so well posted that they can not increase their knowledge by visiting other railroad and industrial shops. Few higher railway officers are so keenly aware of the possibilities of modern machine tools that they cannot well afford to re-study the last machinery budget request by the superintendent of motive power and put back some of those tools which were lopped off.

Air-Conditioning Research

The value of well organized research on the part of the railroads as a whole is no more clearly demonstrated than in the remarkable study made last year by the Division of Equipment Research of the Association of American Railroads on air conditioning of passenger cars. The individual railroads and the Pullman Company have for several years been experimenting with and studying this problem, with the result that on October 1 of last year there were 8,031 air-conditioned passenger cars in the United States and Canada. Several different types of apparatus were in use, and these were in various stages of development, since the first installations in railroad service were made only a very few years ago.

Railroad officers have felt keenly the need for accurate data as to the costs and performances of the different types of apparatus; indeed, without such information it is impossible intelligently to select that type of equipment which will function most successfully under the conditions prevalent on a particular railroad.

Recognizing this need and the importance of prompt action, the Association of American Railroads, through its Division of Equipment Research, laid out a comprehensive plan of research and went forward aggressively to achieve its objectives. Not a few experts acquainted with the problem smiled cynically when they heard of these plans and predicted it would be years before worthwhile information could be assembled and digested. They did not know L. W. Wallace, the head of the division, or the calibre of those associated with him. Representatives of the railroads and of the railway supply manufacturers rallied to the task, giving freely of their knowledge and assistance. As the result, a summary report of last season's tests has already been published, and engineering reports will follow shortly.

Certain important facts and principles have already been established, and plans are being made to follow up other troublesome problems which remain to be solved. Changes have already been made in some of the installations in service and improvements are being made in the design and operation of new equipment.

Some idea of the immensity of the progress already made may be gained from the fact that thorough road tests were made of air-conditioned cars on 31 railroads, involving 594 cars, 5,200 hours and 240,000 car-miles. Laboratory tests were made of 15 air-conditioning systems and six drive mechanisms; 14 cars were tested in the hot room. The analysis of costs is based on an experience record in 1935 of 1,608 cars with a total car mileage of 178,259,768. Comments were recorded from 5,453 passengers in cars under road tests, the exact conditions prevailing when each of these statements were made being a matter of record.

These facts may well be kept in mind in studying the results recorded in an article elsewhere in this issue. The point is that such prompt and comprehensive results are available only where co-operative research on a large scale can be conducted under strong central direction and leadership. There are many other pressing problems in the mechanical department awaiting similar treatment.

Hot Boxes

Under the above title, one of the most comprehensive recent discussions of the causes and effects of hot journal boxes was presented by C. B. Smith, engineer of tests, Boston & Maine, at the December meeting of the New England Railroad Club. As Mr. Smith clearly pointed out, hot boxes may be primarily a mechanical-department responsibility, but they are of concern to the operating department, because of possible upset schedules; to the traffic department, because of delayed deliveries of commercial lading; and to the maintenance-of-way department, because they may result in broken journals and derailments, with attendant damage not only to equipment, but to the track structure.

Admittedly, most of the immediate causes of hot boxes are initiated in terminal yards where corrective measures must first be applied. While the actual number of hot boxes in proportion to the number of journals in service is exceedingly small, the aggregate number of hot boxes on each railroad, as well as on railroads as a whole, is a very substantial figure, and hot boxes constitute a large item of expense, due to damaged equipment, interrupted operation and frequent damage claims for delayed delivery.

With the main conclusions in Mr. Smith's paper, there can be no disagreement: namely, that, under the prevailing system of handling cars equipped with conventional journal bearings, hot boxes cannot be entirely avoided; that hot boxes can be minimized only by the

constant vigilance of an adequate force of inspectors and journal-box packers to cover all cars in all trains; that excessive car impacts in switching must be avoided and journal packing reworked where necessary before trains leave terminals; that, since unfavorable conditions do not always cause hot boxes, inspection forces are sometimes encouraged to take a chance and not provide adequate inspection and servicing when time is limited; that, even when properly serviced before leaving a terminal, journals will sometimes become hot, due to hidden defects; that, if hot-box prevention methods are confined to "the best that can be done under present conditions," the problem will remain acute and probably again be passed on to the next generation to solve.

Considerable worthwhile discussion followed the reading of Mr. Smith's paper, one of the speakers most favorably received being Ralph Hammond, road foreman of engines, New York, New Haven & Hartford, who startled his audience by saying that he *believed* in hot boxes, i.e., hot *fire*boxes. Mr. Hammond referred to earlier days of railroading when a freight train coming down a hill "put you in mind of a comet with hot boxes on each side," and when, as a "hogger" with a long train, his practice was to start out of the terminal and get the train going as fast as he could so that all defective boxes would get hot quickly and the cars could be set out all at one time. Mr. Hammond said that while hot boxes have decreased substantially since the early days, they still constitute a serious problem, particularly on long trains operated at high speeds.

The most prevalent source of difficulty seems to be waste grabs which are said to cause from 55 to 80 per cent of hot boxes. This quite strongly suggests the immediate need of the operating department taking steps to avoid, insofar as possible, excessive shocks to trains and cars, not only in road service, but, particularly, also in terminal handling.

There are several seasons why "the best that can be done under present conditions" will pass the problem of hot boxes on to the next generation for solution. In the first place, present conditions include the waste-packed journal box with its bearing which, though highly developed as to uniform load distribution and ease of renewal, is disturbed in its position on the journal with relative ease under conditions of shock and depends upon a none-too-certain source of oil supply. In other words, as long as a touchy device is to be dealt with its successful operation must depend upon eternal vigilance. But the capacity for eternal vigilance is far from being a universal human quality. In the second place, since the touchiness of the journal bearing arises at several points, a campaign of vigilance directed toward one point which seems to cure one epidemic of hot boxes is ineffective in preventing the next since the cause is slightly different.

The remarkable improvement in the reliability of journal operation which has taken place during the past fifteen or twenty years is the result of reducing to a minimum the uncertainties of journal-box conditions by the development of systematic attention. The uncertainties which still remain, and, no doubt, will as long as the present type of journal bearings are in use, are sufficient to insure that the problem will continue indefinitely to be one requiring special attention. The supervisor who can most shrewdly estimate the arrival of the moment when vigilance with respect to any detail of journal-box attention is relaxed nearly to the danger point and who can then inspire a renewal of that waning vigilance throughout his organization is the one who will have the best records of journal performance.

Twenty-five Years of Federal Inspection

The annual report of Chief Inspector J. M. Hall of the Bureau of Locomotive Inspection to the Interstate Commerce Commission for the year ended June 30, 1936, marks the completion of a quarter of a century of Federal locomotive inspection. Prior to February 17, 1911, when the Locomotive Boiler Inspection Act became obligatory upon the carriers, it was common practice to keep locomotives in service when they were known to be in bad condition, thus subordinating the making of needed repairs to the requirements of power demands. In many instances locomotives were continued in service until failure occurred, resulting in the death or injury of the engine crews.

The twenty-fifth annual report of the Bureau of Locomotive Inspection, abstracted in this issue, shows that 10 men were killed and 91 were injured during the fiscal year ended June 30, 1936, as a result of failures of locomotive boilers or boiler appurtenances, whereas in the annual report for the year ended June 30, 1912, it was reported that 91 men were killed and 1,005 were injured. In the first year during which the Locomotive Inspection Act was effective 6,968 locomotives were held out of service for repairs. This number was reduced to the low figure of 527 in 1932.

The wisdom of the policy of Federal locomotive inspection is illustrated by the improved conditions of locomotives during the past twenty-five years and the reduction in the number of fatalities and injuries from locomotive accidents. The expressions "That's good enough," "Hurry up and get her out," and others of similar character have for the most part been abandoned, especially with respect to defects which might result in disasterous accidents.

However, the latest annual report shows that 16 persons were killed and 215 were injured, in locomotive accidents, of which 10 deaths and 91 injuries were directly attributed to boiler or firebox failures. It is the conscientious duty of every railroadman who is responsible for repairing or inspecting locomotives to aid in reducing such accidents. No locomotive should "go" with defects which have the remotest chance of causing failure. Or would that be the millennium?

THE READER'S PAGE

Shopman Disagrees with Mr. Williams

To the Editor:

Was much interested in the comments on Mr. Williams' articles on scratches and their results, appearing in recent issues, and perhaps it is well to permit a metallurgist to wander around the shop with a microscope occasionally. However, after carefully reading several of these articles, one of our foremen recently remarked:

"I have been in charge of the piston job for 23 years and have seen all sorts of fillets made on the piston-rod crosshead ends, and have only seen one break in that part of the rod, while hundreds have developed cracks between the end of the keyway and the largest part of the taper. There is a thread cut on the other end of the rods, about two inches of deliberately made grooves one-eighth of an inch deep and one-eighth of an inch apart, and I have seen but a few break there. So it appears to me that the slight tool scratch complained of is more or less just so much 'hooey.' I have seen most carefully ground crank pins break about one inch in the wheel seat in less than two years after being applied, while others of the same type, size, and service, applied just as the lathe tool left them, were running until they were removed as being down to the limit. Also thousands of crank pins trued up in the roundhouses by means of portable crank pin truing devices, every one showing tool marks, but never yet heard of one breaking unless in a wreck."

These articles are likely to get the mechanical and non-practical officers of the railways worked up to a point where each man who leaves a slight tool mark or scratch on his work will have to be taken out of service—then what?

A Westerner.

(This letter was received just as we were going to press and so Mr. Williams has not had an opportunity of seeing it. Interestingly enough, however, his article in this number is concerned with the type of piston-rod breaks in the taper fit, to which reference is made in the letter.—The Editor.)

Machinist Objects to Carrying Microscope in His Kit

To the Editor:

The series of articles by F. H. Williams, published in recent issues of the *Railway Mechanical Engineer*, dealing with material failures, has been the cause of much discussion and argument in our vicinity. Machine-shop men particularly have not hesitated to express their opinions, and while agreeing with him in some of his failure analyses, they do take exception to some of his statements.

In one article particularly he states that with a tool properly ground with the correct clearances and set correctly, a fillet can be turned perfectly smooth without leaving any scratches or tool marks. I wonder how long ago he tried this? With the kind of steel that axles and crank pins used to be made from, it was no trick, but with our present-day alloys I believe it would tax even Mr. Williams' ingenuity — although he might use the best grade of high-speed tools—to grind or set a tool that would not crater and leave a scratch that a microscope would not uncover.

The railroad on which I am employed is continually going to considerable expense in developing tools that will cut without scratching—no filing allowed, our inspection being very rigid. Recently a piston rod was condemned because of the fillet adjacent to the crosshead fit having faint tool marks, although I have yet to see a rod break at this point. The fracture generally occurs just inside the crosshead. Piston-head fits and fillets are also carefully machined to a mirror finish; then we deliberately cut a sharp-cornered thread for a nut on the end, but they never break there.

Driving axles are received from the steel manufacturer rough-turned; same have been turned with ¼-in. feed, in appearance like a shallow thread. We turn and grind the wheel fit and journal; fillets are polished; the center is left just as received from the manufacturer. but the fracture invariably occurs just inside the wheel fit.

In my experience, the majority of fractures occur in driving axles, crank pins and piston rods at the point where heavy external pressure is applied, and judging from a paper read by a research engineer at a meeting of the American Society of Metals at Cleveland, others have had similar experience. Parts of this paper read as follows:

"No. 1. A press fit reduces the fatigue strength of an axle to less than half the strength of a similar axle not assembled by a press fit.

"No. 2. Surface rolling of the axle at the sections that are subjected to pressure practically restores the full strength."

All this, to say the least, is confusing to the ordinary mechanic. Mr. Williams says that tool marks are the cause of the fracture; the research engineer says it is a result of external pressure. Possibly it is a combination of both.

Rolling would be a fine solution for the machine shop man if we could be allowed to do it. Tool marks and scratches could be rolled in to the extent that a microscope would hardly uncover them, but everyone knows that they are just rolled in and not rolled out.

Assuming that Mr. Williams is right in that tool marks or scratches are the primary cause of fatigue and that the research engineer is also right in that external pressure reduces the fatigue strength, is it not only fair that the steel manufacturer and metallurgist should assume some of the responsibility and develop a steel that will eliminate the necessity for a microscope as part of a machinist's kit? Pressure fits with the present designs we are compelled to use; in my opinion all failures that occur inside the fit are pure and simple material failures.

Machinist

["Machinist" has apparently overlooked the fact that Mr. Williams has placed much emphasis on stress-corrosion and the part it plays in failures. Indeed, he has quite frankly stated in several instances that it was a question as to which cause—stress-corrosion or poor finish—was more largely responsible for a given failure. The metallurgist has done wonders in improving the materials used in car and locomotive construction. Apparently the finer and stronger he makes them, the more

susceptible they are to fractures starting from roughnesses on the surface finish. Can he be expected to meet "Machinist's" specifications in the last paragraph of the letter?—Editor]

Is This A Car Foreman?

To the Editor:

In an endeavor to enlighten our inquiring roundhouse foreman, I will enumerate a few of the qualifications that are insisted upon before one is considered for this highly important position.

First, he must be a gentleman, as defined by Webster. He must also be educated for he is confronted with the task of building, rebuilding and maintaining our luxurious passenger cars, with their intricate air conditioning, water raising, high-speed brakes, heating systems and rocking-chair riding qualities, as well as mail cars manned by much more exacting men than his tallow pots; he must also know how to repair or rebuild any car owner's car in accordance with A. A. R. rules and owner's standards, rendering bills for such repairs in line with those rules; he must be conversant with loading rules covering all classes of lading (roundhouse foremen excepted); he must have full knowledge of the I. C. C. laws covering all kinds of equipment, even engine tenders.

Our good friend the roundhouse foreman should not confuse work in the car department with his in the roundhouse where he hands some white slips to his nut splitters and after the work is completed calls a crew to run the engine up and down by the roundhouse to see if it will stay together and then with the aid of the traveling engineer and six extra oil cans, try to make the next terminal.

The average car foreman has many crafts under his supervision, such as carmen, painters, tinners, pipefitters, acetylene and electric welders, blacksmiths, coppersmiths, upholsters, patternmakers and a few machinists, and he usually finds the latter are very nice fellows and really willing to learn after he has them under his guiding hand a few months. As a suggestion to master mechanics, it may be well to consider machinists with car department experience for future roundhouse foremen, as they really know what it is all about.

A Car Foreman

Metallurgists Too Much For Shop Inspector

To the Editor:

The series of articles on locomotive failures by F. W. Williams, which has been appearing in your paper, is of exceptional value to the inspector whose duties are to investigate and report all failures and their causes, but the problem is how far we can go economically with fine finishes that will stand microscopic inspection.

Perhaps I can illustrate my meaning better by relating my experience at a metallurgists' meeting which I attended a few years ago. Having a couple of hours before train time, three of us barged into the meeting, although I confess it was more to kill time than anything else. It was about zero outside and comfortable and warm inside, which was the execuse one of my companions gave for going to sleep. However, my curiosity was greater than my powers of understanding and I managed to keep awake, although most of the proceedings and speeches were no clearer than mud.

I did start to get interested in the pictures, however. They showed pieces of steel magnified several hundred times, illustrating fine hair checks in different places, the speaker explaining the cause. Eventually one speaker, about six feet six inches tall, every inch of which looked the scholar, showed several pictures of what we assumed were different pieces of steel with the hair checks in different places, and then abruptly finished the discussion and me at the same time by saying, "Gentlemen, these are pictures of the same piece of steel and the reason the check shows in different places is because the pictures are taken with different machines, and the machine has not yet been perfected that will magnify so many times clearly." After this I gave up and joined my companions in sleep.

Inspector

[Mr. Williams has not yet seen this letter and it is only fair to say that most of the photographs which have been used with his articles show magnifications of only a few diameters.—Editor]

In The "Wee Sma'" Hours

To the Editor:

Like a good many others, I enjoy reading the stories of railroad life written by Walt Wyre for your paper, and, no doubt, a good many are true stories of actual happenings. The trials of the day foreman, general foreman and the car foreman are many, I will admit, but the following lines should be food for thought for the pen of our friend Mr. Wyre.

While I agree that stories of the three foremen Mr. Wyre has so far written about are true to life around most any terminal, the man who really has tough problems is the last man usually thought of, and I speak of the night roundhouse foreman at any division point. He is the man who does the finishing up and is always operating with less help than he needs. He is the man at night that deals directly with the operating department and the dispatcher, and regardless of whether an engine is wanted for an extra or to double-head a regular train, or if the snow plow is wanted, the wrecker, or possibly a car brassed, the night foreman must handle these items in addition to getting his regular work done, for the general foreman and the car foreman are home asleep. Possibly one car inspector is around with more cars to look over than he can get to.

To start with, before his promotion to foreman, the average night foreman was considered a good nut splitter by his master mechanic, and thus he was in due time recommended for promotion; and the first thing he learned, when taking over the night job was that he must be the judge not only of the machinist's work, but of the boilermaker's, pipeman's, electrician's and all others', including the stationary fireman's. All the functions to which a man is usually assigned in the daytime become a personal matter for the night foreman, as he won't have a man for every job. It is a well-known fact that every accessory to the roundhouse, such as the coal chute, water-treating plant, turntable, water tanks, etc., always picks out some time after sundown to fail.

So I say to you, Mr. Editor and Mr. Wyre, while you are giving out sympathy for the others, go to any large roundhouse some night and follow the night foreman around from 6:00 p.m. to 7:00 a.m. and I know you will learn some real railroading problems, and see them handled right now.

Night Roundhouse Foreman

Gleanings *from the* Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

Improve All Services

Another point the railroads might consider is improving all of their services as best they can, rather than concentrating on one or two trains—and letting the balance of their trains suffer by comparison. After all, one "super" train cannot possibly bring in all of the revenue on a railroad, and cannot cover all points, so why not try and spread out the money to make the other trains as attractive as possible?

"Finished" Apprentices

Now that business has started to increase and apparently promises to become heavy, the railroads are seriously handicapped by the lack of experienced men. Despite the statistics on unemployment, a sufficient number of experienced men is not available and "finished" apprentices are hopeless. Because of greed for profit, or in the interest of increased production for low rates of pay under union agreements, apprentices on some railroads are required to serve four years finding out how to do not more than three or four operations. When such apprentices have "finished" their four years they do not have the required experience or ability, they have little or no confidence and are totally unfit to assume the responsibilities required of a mechanic.

Model Railroad Nuts

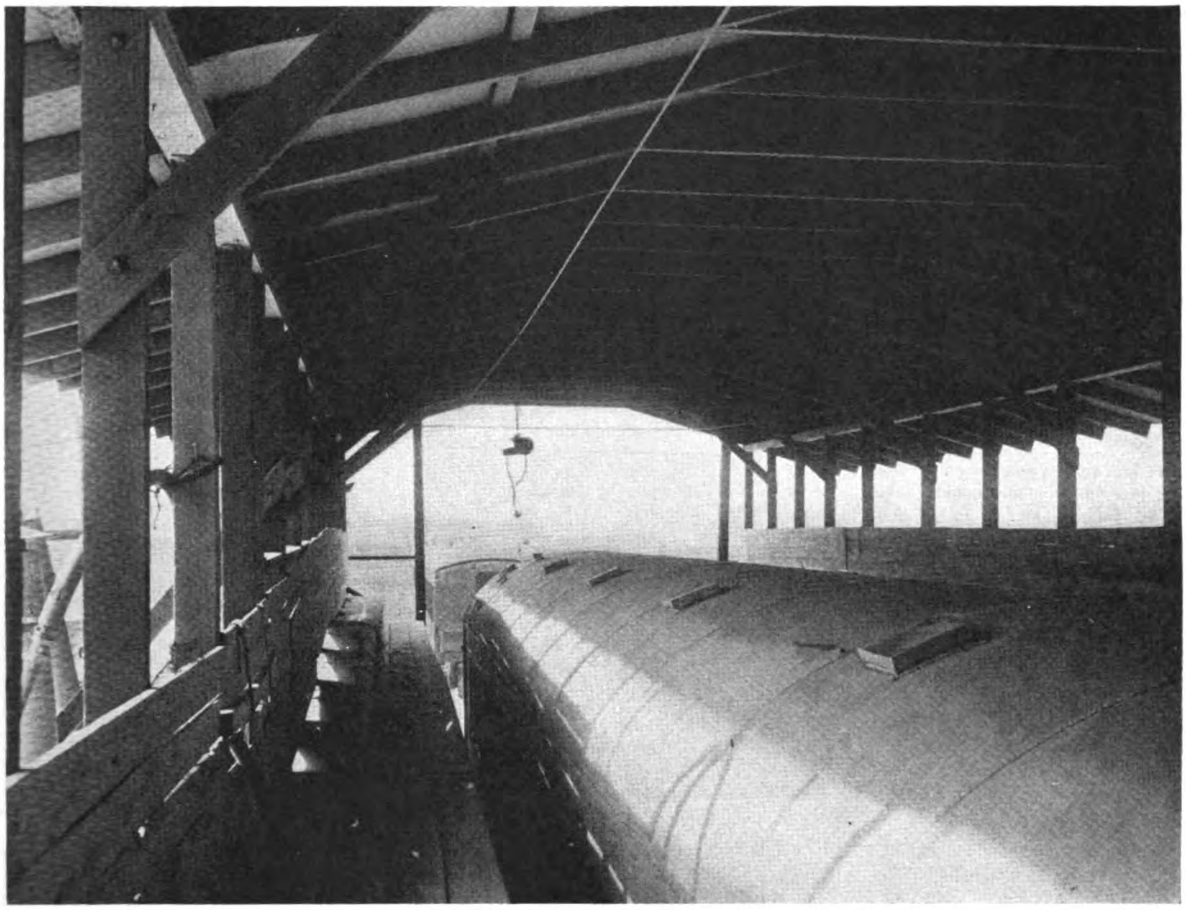
You, no doubt, are aware of the hobby of model railroading and how it is spreading over the country. This is playing a really important part toward an era of good feeling to the American railroads. It is interesting to note that each of these enthusiasts has a special reason for the particular model he makes or purchases. Where the hobbyist chooses a certain railroad to model, he may be a stockholder, he may like the road's passenger service, or he may like the appearance of the motive power. One leading manufacturer in his line of business was won over because he liked the clean way both passenger and freight locomotives were kept. Naturally he favors this road when he travels and, above all, with his shipments. The model railroader soon learns many fine points of railroads. They can soon pick out the faults in the make-up of a passenger train; their enthusiasm is not very high for the road that insists on operating day coaches behind Pullman cars, especially the observation type of Pullman. They are aware that operating conditions make it more economical, nevertheless the fine touch is lost. Incidentally, there are many thousand travelers among these model "bugs" that do not want to see the open-end observation Pullman pass into history.

How Big Is A Foreman?

One of the greatest things that come to me is in having a foreman who is broad and big enough to carry the responsibility of his department when failures arise, and not try to shift the responsibility on to others who come under his charge. Much has been said regarding the roundhouse foreman. I believe that the most successful roundhouse foreman is the one who will meet the men who operate the locomotives with a smile and is ready and willing to co-operate with them in the little things that they ask. I realize that if the mechanical department, from the superintendent motive power to the roundhouse foreman, has the full co-operation and good will of the men who operate the locomotives, they will surely be successful, as these men can either make them or break them. In order to do this the heaviest responsibility falls upon the roundhouse foreman, who must meet and greet them with a smile and always be ready and willing to listen to their complaints. Even though you may know that these complaints do not amount to a great deal, the men who are trying to express them do feel that they are very important and if you fail to listen to them, they feel very much hurt. Therefore, in order to be a successful roundhouse foreman, you have to listen patiently to many things that are very boring.

Merchants Express of the Delaware, Lackawanna & Western.—Photographed at West Summit, N. J., by Thomas T. Taber

With the Car Foremen and Inspectors



Interior view of the shed showing facilities for sand-blasting car roofs

Sand-Blasting Operations At Burnside Shops

Sand-blasting operations on Illinois Central passenger cars are performed in a special shed adjacent to the passenger car shop at Burnside (Chicago), Ill. This shed, 150 ft. long by 20 ft. wide by 23 ft. high, comprises a wooden frame with sides extending nearly to the sheet metal roof, having one end leading into the car shop and the other end open. The shed covers one track, and is equipped with double-side scaffolds 36 in. and 10 ft. high, respectively, on which operators may stand while sand-blasting the sides and the roof.

A suitable supply of sand is carried in drier and storage cars just outside of the shed in which the sand is properly dried and screened. The storage car is tilted to give gravity feed to one end from which the sand is fed under manual control into a 22½-in. by 54-in. tank set vertically in the ground. After the filler plug is closed and air pressure applied to this tank, the sand is raised through a 1¼-in. pipe into a 40-in. by 60-in. tank also set on end and designed to hold the sand in readiness for blasting operations. There are three of these 40-in. by 60-in. tank units; also one large reserve tank for sand and another large reserve tank in the shop air line to avoid fluctuations in air pressure when multiple sanding operations are being carried on.

Each of the 40-in. by 60-in. tanks has an opening on top for the escape of air while being filled with sand. The sand drops from the bottom through a pipe connection to a sand-mixing valve in which sand and air are mixed as they pass at 70-lb. pressure into the air-delivery hose. The amount of sand delivered to the air stream is governed by the air pressure and the size of the hole through which sand is fed to the mixing valve. Good results are secured by making this a 9/16-in. hole drilled in a removable plate which may be substituted for a plate with a larger or smaller hole if required by special conditions. Two other valves govern the air pressure on top of the sand and in the hose.

A 1½-in. standard sand-blast hose is used, the service life secured being about three months. Standard 1¼-in. air hose couplings are employed, also a 1¼-in. by ¾-in. or ½-in. reducer coupling, dependent upon the nozzle-size required for the best results. Straight nozzles, 20 in. to 50 in. long, are used, the ½-in. size being more economical for sand-blasting small parts. The best cutting action is secured when directing the sand against the part being cleaned at an angle of about 45 deg. The hardest material to cut is the enamel on vitrified hoppers.

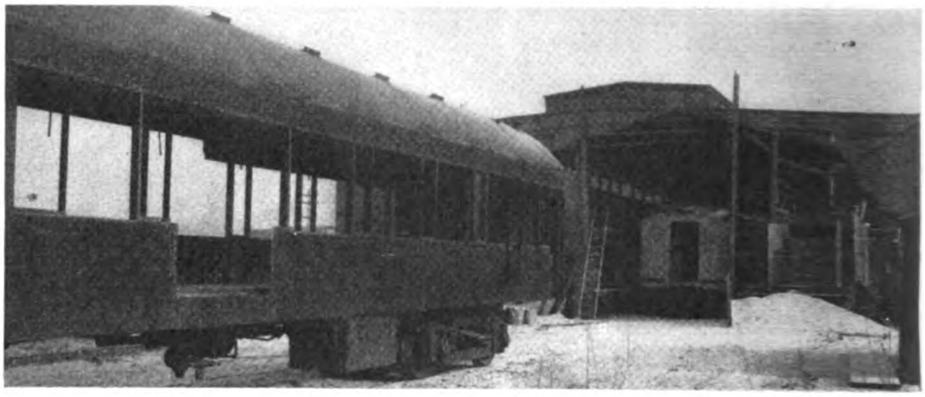
Particular precautions are taken to assure the safety and good health of the sand-blast operators. The men receive monthly physical examinations and are employed on this work only for four-month periods. The latest type of protective hood is provided for the operators, clean filtered air being supplied to the hoods at a pressure of about 5 lb., adjustable by means of a needle valve. The hose is attached to the man's belt in such a way as to take the weight off his head.

Preparatory Work Necessary

The kind of preparation necessary in getting cars ready for sand-blasting depends upon the type of car and nature of work being done on it. All cars are stripped and passed into the sand-blast shed on their own trucks. The easiest job is an all-steel car which may be sanded inside and out without special protection. If the car interior does not require sanding, a spare set of convas-equipped sash is applied in place of the regular glazed sash to protect the interior. Composite interiors which require sanding of the metal ceiling have the wood deck molding shielded with canvas. Exterior sanding is performed by one man working simultaneously on each side of the car or on each side of the roof. For overhead sanding, the weight of the relatively long and heavy hose is carried by a pulley on a guy wire, there being one wire on each side of the shed. When working on both sides of the car or roof at the same time, the sanding operations are staggered to avoid one man interfering with the other. Underframe parts and trucks are sand-blasted by the ground men. After the car is completely sanded, it is blown out, pulled, and the accumulated sand shoveled up and returned to the storage car for re-use until the cutting edge is reduced too much for efficient sanding.

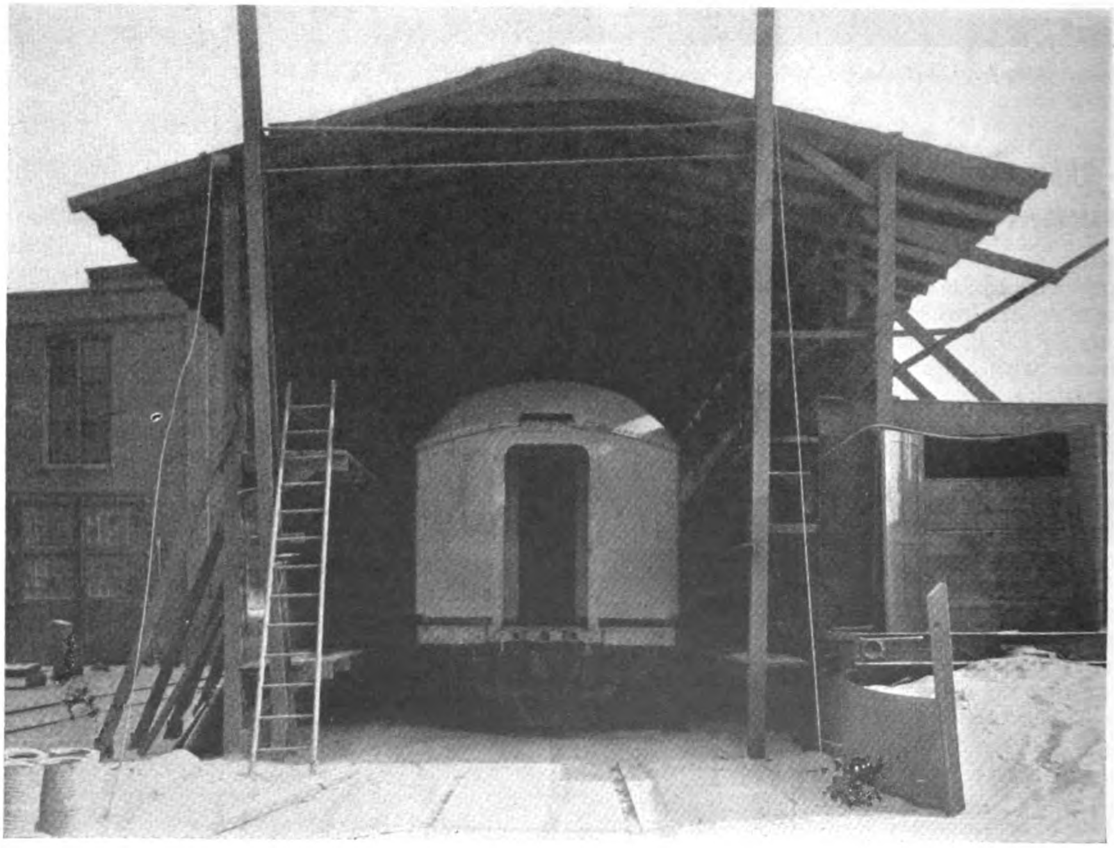
Cost of Sand-Blasting

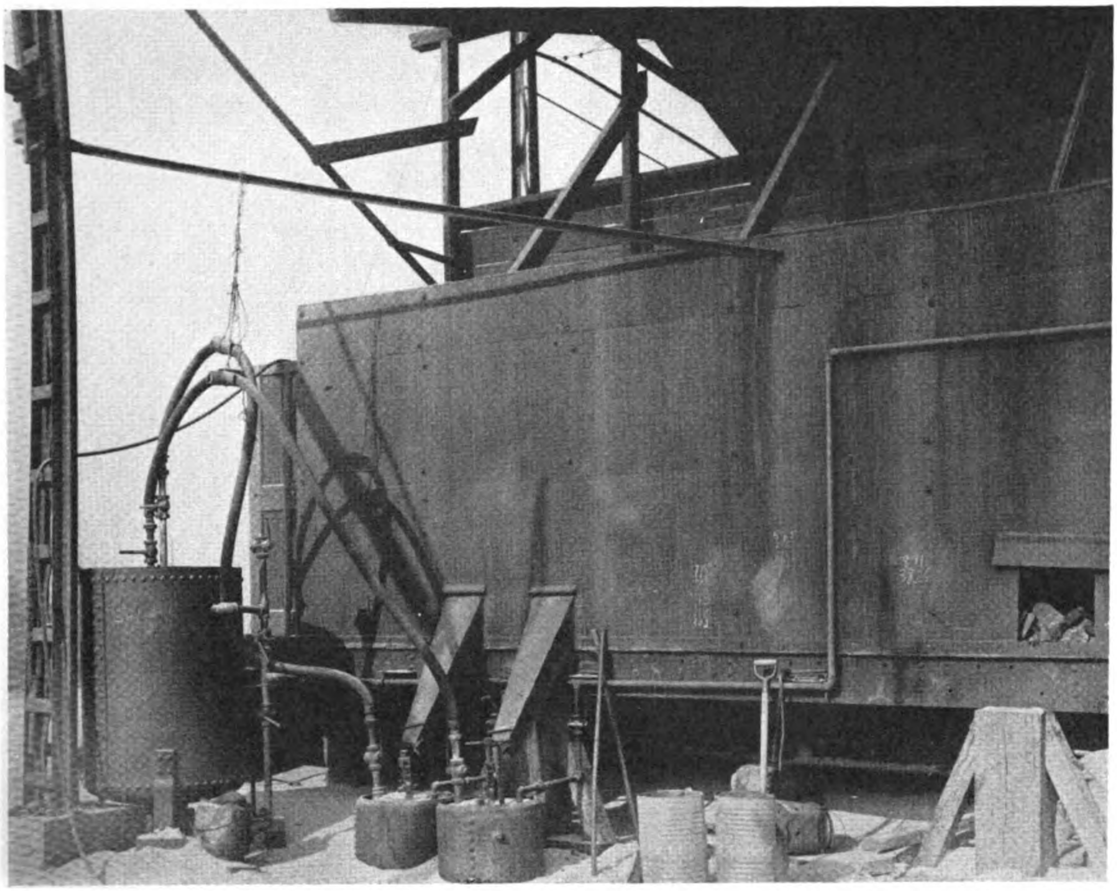
In many instances, some of the elements of cost in sand-blasting operations are overlooked and the result is that railroad men quote figures which are too low and which prove misleading regarding the real cost of this important work. As would be expected, the actual cost of sand-blasting depends primarily upon the type of car,



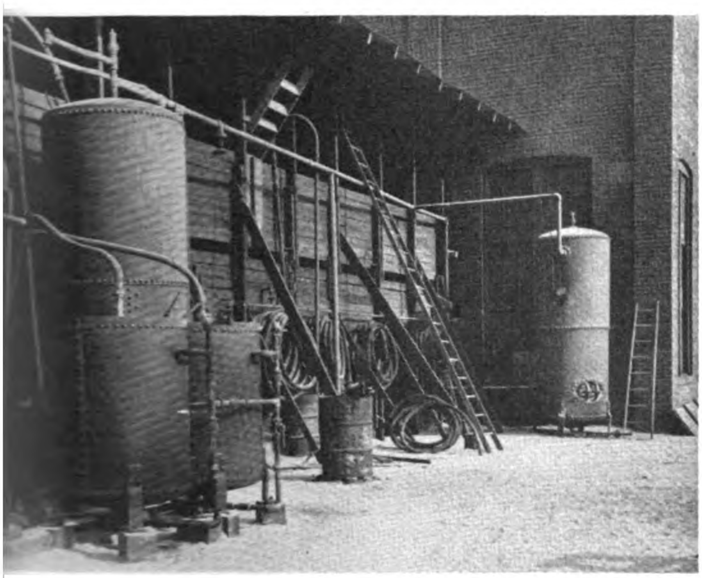
Right—Car due for extensive conversion job ready to enter sand-blast shed

Below—Sand-blast shed at Burnside shops of the Illinois Central





Sand-blast unit used in cleaning small car parts outside the shed



Sand-blast tanks and equipment outside the shed

its condition and the amount of reconditioning work being done on it. The car size, amount of interior metal finish, window area and condition of the underframe and trucks as regards corrosion all are important factors.

Referring to the tables, it will be observed that the sand-blasting of a typical Illinois Central baggage car cost $121.45, including all elements of cost, and sand-blasting a typical coach cost $87.36. The largest single element of cost in the baggage car is for sand-blasting the inside of the car, including the ceiling, and the next largest item is for sand-blasting the heater coils, guards, ventilator collars, handrails, etc. In the coach, the largest single item is for sand-blasting the roof, and the next largest is for cleaning up after sand-blasting. The cost of air, steam and electricity is included in the 20 per cent allowance for shop expense.

Cost of Sand-Blasting Baggage Car

Parts Sand Blasted	Hours	Labor	Mat'l.	Total
Trucks, springs and equalizers	18¾	$8.80	..	$8.80
Inside of car, including ceiling	75¾	32.29	..	32.29
Outside of car and roof	55	23.87	..	23.87
Heater coils, guards, locker, ventilator collars, center castings and hand-rails	70	30.27	..	30.27
New panels	5¾	2.53	..	2,53
2 battery boxes and equipment box	5	2.58	..	2.58
Generator castings	2	.87	..	.87
Total sand blast	233¼	$101.21	..	$101.21
Plus 20 per cent shop expense				20.24
Grand total				$121.45

Cost of Sand-Blasting Coach

Parts Sand Blasted	Hours	Labor	Mat'l.	Total
Generator castings	2	$.92	..	$.92
Trucks and springs	14½	6.93	..	6.93
Roof	38¾	18.46	..	18.46
Outside of car	27½	12.40	..	12.40
Inside of car	24	11.29	..	11.29
Clean up after sand blast	41	17.40	..	17.40
Battery boxes	3½	1.60	..	1.60
New patches, window stops and water collar stands	8¼	3.80	..	3.80
Total sand blast	159½	$72.80	..	$72.80
Plus 20 per cent shop expense				14.56
Grand total				$87.36

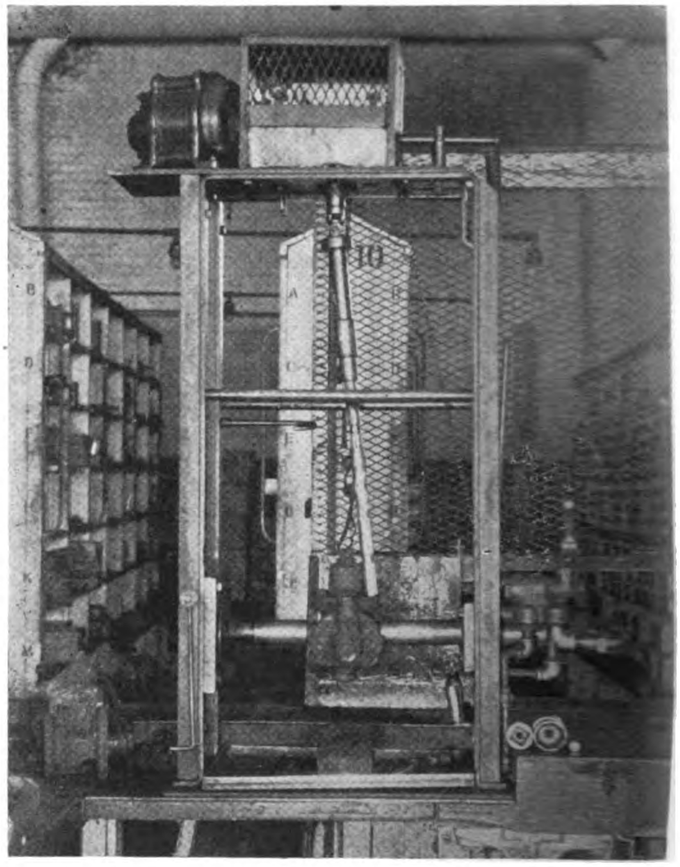
Machine for Dismantling Triple Valves

The triple valve dismantling machine shown in the figures has sufficient power for the removal of nuts, caps, and retarding devices (on the K type triple) and can be used to dismantle a triple valve completely in two minutes. Power is supplied by a 2-hp., 1,800-r.p.m. motor geared to a shaft equipped with a friction spring release clutch which is in turn connected through a universal joint to a telescopic spindle.

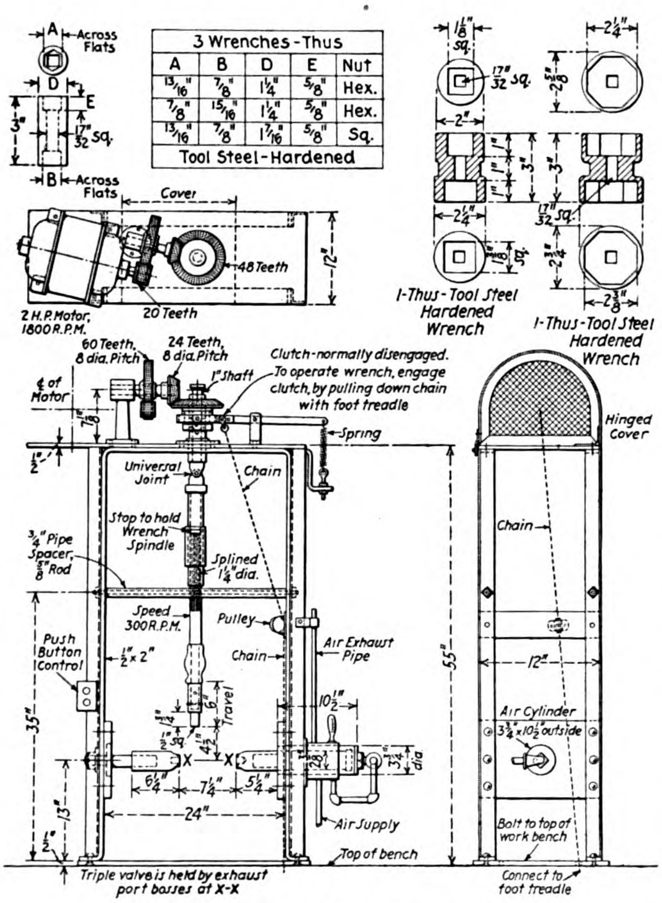
The triple valves are held by two cylinders mounted on the frame. The ends of the cylinders, shown as *XX* in the drawing, are drilled and counterbored to fit over the triple-valve exhaust-port bosses, and drilled to a depth sufficient to prevent contacting the pipe plugs which are screwed into the exhaust-port threads. The left-hand cylinder is stationery, while the right-hand cylinder is fitted with a plunger operated by a straight-air brake valve.

When dismantling a triple valve, the valve is placed between the plungers at *XX* with the check-case plug resting on a wooden block set in the center of the table, and with the cylinder cap pointing towards the operator. The operating valve is then placed in an open position which causes the plunger to move out of the right-hand cylinder, thus clamping the triple valve between the plunger and the left-hand cylinder. The valve can be turned so that either the cylinder cap or the check-case bolts are in position. The proper socket wrench, dimensions of which are shown in the drawing, is placed on the spindle and, due to the fact that the shaft is telescopic, the wrench can be brought down to contact with the part to be removed.

A foot pedal is connected by means of a chain and a spring balanced lever arm to a clutch at the top of the frame. When the foot pedal is lowered the clutch engages, causing the wrench to revolve. If it is desired to lock the triple valve in position, a hook located on the front face of the left frame is placed in the check-case opening.



The dismantling machine with a triple valve set between the clamping cylinders



3 Wrenches-Thus				
A	B	D	E	Nut
13/16"	7/8"	1 1/4"	5/8"	Hex.
7/8"	15/16"	1 1/4"	5/8"	Hex.
13/16"	7/8"	1 7/16"	5/8"	Sq.
Tool Steel-Hardened				

Details of the triple valve dismantling machine

Questions and Answers On the AB Brake

118.—*Q.—What ports are open in the other step of service position?* A.—The same as in the first except that communication is now closed between brake pipe and brake cylinder by the limiting valve. This occurs when a predetermined amount of air has been accumulated in the brake cylinder. Any further pressure in the brake cylinder is obtained from the auxiliary reservoir.

119—*Q.—What ports open in service lap position?* A.—The same as in above, with the following exceptions: Flow of auxiliary reservoir pressure to brake cylinder is cut off by the service graduating valve. The opening from quick action chamber to atmosphere is cut off by the emergency graduating valve and communication is re-established between brake pipe and quick action chamber via charging choke.

120—*Q.—What ports open in emergency, first stage?* A.—Quick action chamber to vent valve piston chamber. Quick action chamber to atmosphere via choke No. 109. Brake pipe to atmosphere past the unseated vent valve. Brake pipe to the accelerated-release check valve chamber. Auxiliary reservoir and emergency reservoir to brake cylinder past the inshot valve, and the two reservoirs are connected to their respective checks in the du-

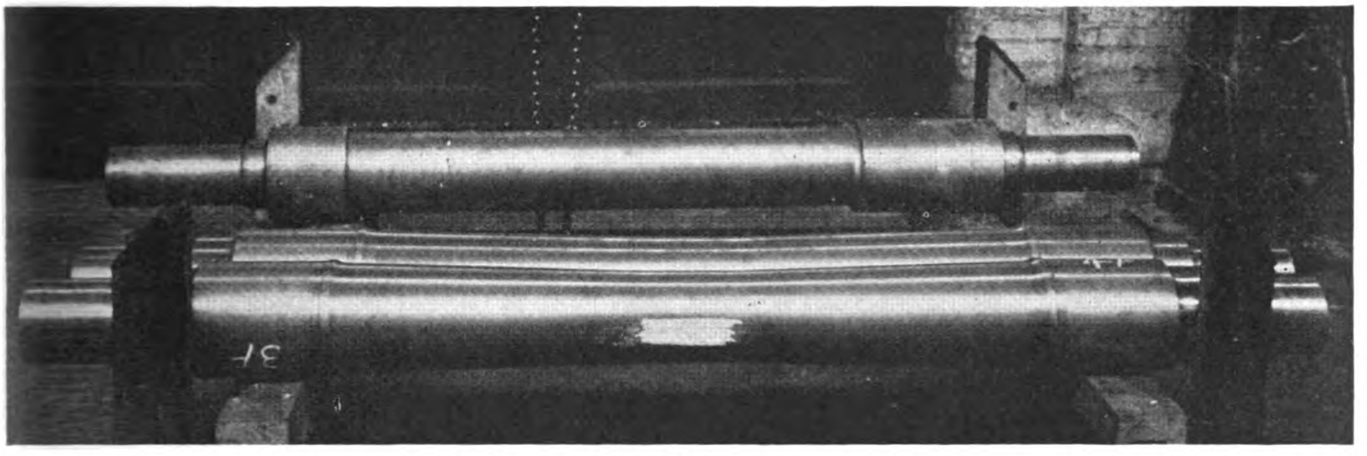
plex release valve. Emergency reservoir to accelerated release piston chamber, and to spill over checks and strut diaphragm. Auxiliary reservoir to the release-insuring valve.

Precision Wheel and Axle Work

The advent of modern light-weight high-speed trains has served to emphasize the need not only for reliability in wheel service, but for accurately-balanced wheels, in the interests of smooth riding and reduced wheel stresses.

The wheels and roller bearings are dismounted in the wheel shop and all parts subjected to accurate calipering for wear and inspection for possible defects. The axles are thoroughly cleaned, submerged in hot oil at 250 to 270 deg. F. for five minutes, after which they are again cleaned and whitewashed with a mixture of whiting and alcohol. After being allowed to dry, they are hammer-tested with a soft hammer so that any oil in the smallest hairline crack will ooze out and be readily visible against the white coating. All of this inspection work is done under the supervision of a metallurgist from the test laboratory, and if any defects are developed, such as small cracks, arc marks, dents, etc., the axles are rejected.

The axles for high-speed trains are made of carbon steel, heat-treated and double normalized. New axles,



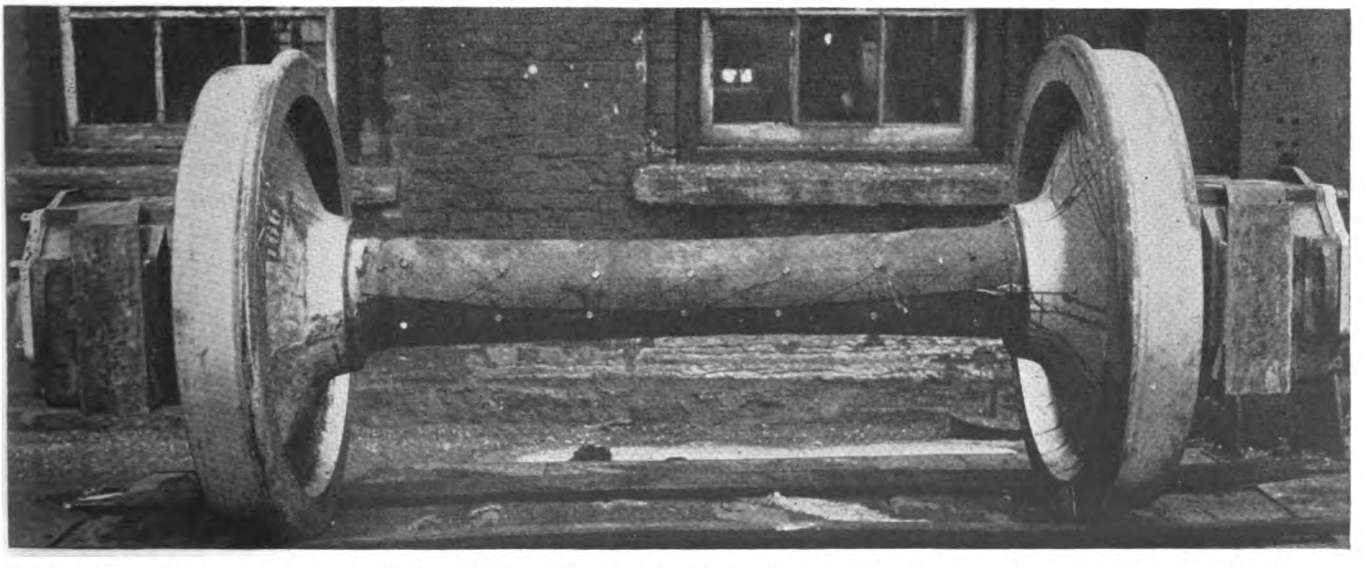
Group of finished Zephyr car axles ready for inspection before wheel mounting

The greatest of care is exercised in inspecting, machining and mounting all parts of the wheel and axle assemblies, including the roller bearings, and the latest practice is to machine the rolled steel wheel hubs and rims after being bored and to grind the treads.

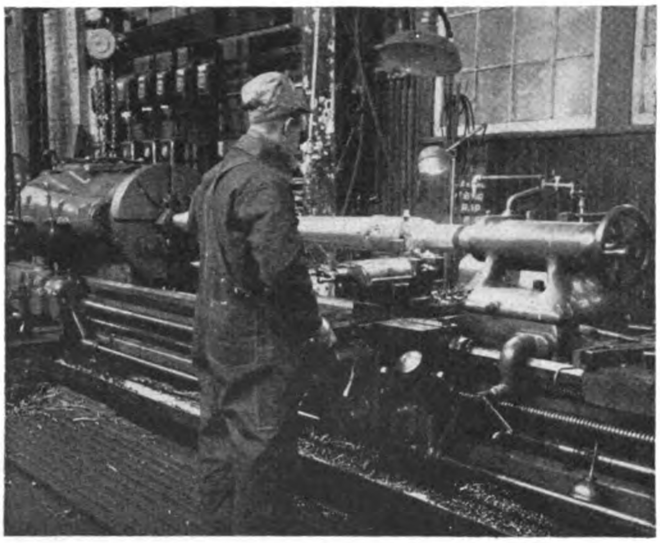
The illustrations show how some of this work is performed at the Aurora, Ill., shops of the Chicago, Burlington & Quincy for car wheels which are to be used under the Zephyr trains operated by this road. Both new and replacement wheels, needed for the protection of this service, are shipped to Aurora shops from terminals such as Chicago, St. Paul, Minn., and Denver, Colo., where Zephyr trains are maintained.

purchased rough turned about ¼ in. above the finish size, are re-machined to a smooth finish all over in a 24-in. engine lathe particular attention being paid to the provision of large well-polished fillets. The ends on which the roller-bearing cones are pressed are ground and the wheel fits are smooth machine-finished. Between the wheels, the axle is smooth machine-finished and no tool marks are allowed.

New wrought steel wheels are supplied rough turned and bored, with 1 in 20 taper treads on power wheels and semi-cylindrical treads on trailer wheels. The wheels are machined on the vertical turret lathe being bored accurately and smoothly with the proper shrinkage al-



Zephyr wheel-and-axle assembly with Timken roller bearing boxes in place and axle covered by heavy canvas for protection during shipment



Machining Zephyr car axle on a Boye & Emmes 24-in. engine lathe at Aurora shops

lowance for a press fit on the axle. The finish cut is made with a double-end floating tool, the tolerances being .0005 in. in diameter and .001 in. taper. The wheel is faced lightly on the hubs and rims to overcome any possible irregularity in exterior surface and to bring it in accurate balance. The inner wheel hub is undercut slightly to reduce axle stress just inside the wheel fit and prevent the starting of a fatigue crack at this point. After mounting the wheels in accordance with standard practice, the treads are ground perfectly round to within a tolerance of .005 in. Reconditioned wheels also are ground on the treads after being turned.

Assembly of the roller-bearing cones, journal boxes and parts is made in accordance with rigid instructions, based on Timken experience in assembling a roller-bearing unit, which will give maximum satisfaction and reliability in service. The greatest care is exercised in handling axles about the shop, felt pads being invariably inserted between the axles and any lifting chains which may be used. Reference to one of the illustrations shows the heavy oil-impregnated canvas cover which is applied over the center of the axle and securely laced in place to protect the axle against accidental marring or corrosion while wheel and axle assemblies are being shipped from place to place.

Stack-Cutting Plate Material*

To meet the demands of modern mass transportation it has been necessary for the railroads to set up heavy repair programs on production-line schedules with movements or deliveries of cars within time periods of from 18 to 24 min. The maintenance of the production-line schedules is dependent upon the ability of the fabrication department to furnish new material or parts for replacement of those which are unfit for further service, on time.

The fabrication department is called upon to manufacture thousands of identical pieces during the course of a regular heavy repair program and the development of stack cutting of plate material by the oxy-acetylene flame-cutting process has proved to be the greatest step forward in fabrication methods that has been made in years.

As all of us are undoubtedly familiar with the use of oxy-acetylene process for the cutting of iron, and its principal alloy, steel, there is no need for any discourse on the reaction of pure oxygen with iron and, therefore, only a description of the practical use of the oxy-acetylene cutting process as applied in our shop to the manufacture of freight-car parts which are fabricated from steel sheets or plates is presented, with the hope that this information may prove of value to those having similar problems.

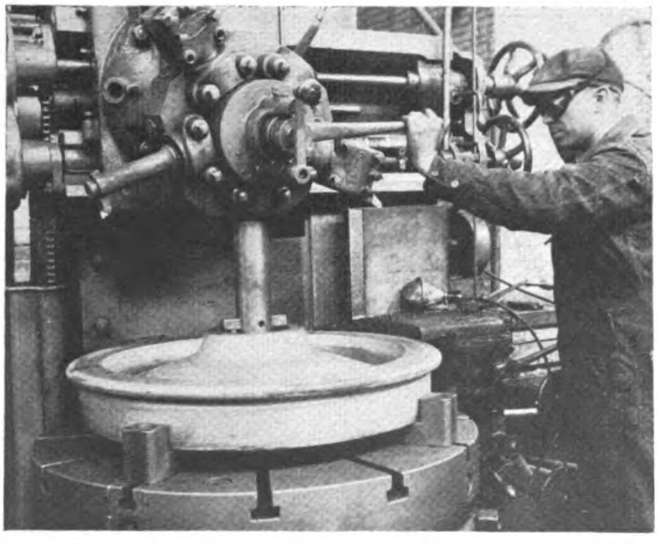
Stack cutting, as the term infers, means the cutting by the oxy-acetylene process of sheets or plates piled or stacked upon one another to a definitely determined height. It is, of course, evident that the cutting torch must be moved over the stack mechanically to obtain smoothly and accurately cut edges, and it is therefore a machine operation.

The machine installed at our shop has a cutting range of 81 in. transversely and 24 ft. longitudinally. This large capacity was provided to meet the production demands of the fabricating shop and permits the economical cutting of four different parts of large dimensions in progression.

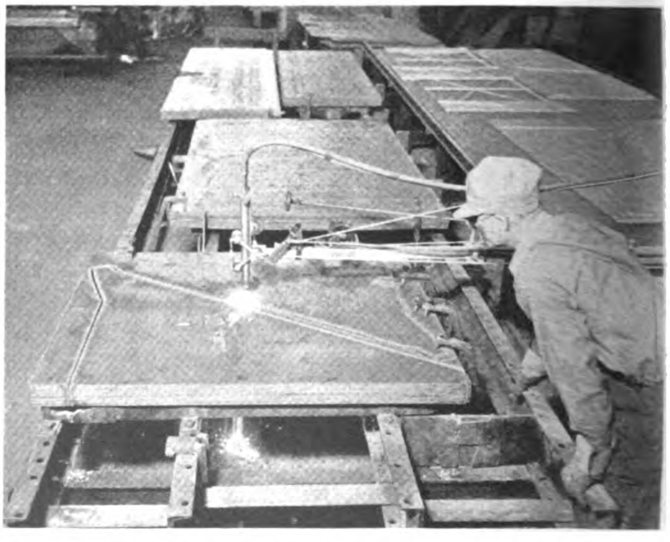
The Template Table and Cutting Jigs

The cutting machine is the type which is automatically guided by means of full sized templates, the guiding mem-

* Paper read at the 37th Annual Convention, International Acetylene Association, held November 18, 19 and 20, at St. Louis, Mo. Mr. Orr is superintendent of car shops, Cleveland, Cincinnati, Chicago & St. Louis, Beech Grove, Ind.



Finish boring a Zephyr car wheel with double-end floating tool in a Bullard vertical turret lathe



The gas-cutting head in operation—Supplementary hand clamps are used where necessary

ber being an aluminum rail suitably fixed to a base. As all of the operations being performed by the cutting machine will be repeated at intervals, permanent templates have been constructed. Due to the large size of the parts cut and the corresponding size of the templates, considerable thought and study was devoted to the development of a template base which would meet the requirements of both strength and lightness. The material selected is ⅜-in. plywood properly reinforced by ⅜-in. by 1½-in. strips attached to the under side with wood screws. The larger templates are made in skeleton form to reduce the quantity of material used and are so designed as to provide a secure base along the line of cut. When in use, the templates are bolted to the top of the cutting-machine table and only the original adjustment is required as the templates are positioned with relation to permanently located jigs and stops. A change from one operation to another consumes but a very short time, as the templates can be exchanged without further adjustment of position.

The stacks of sheets or plates are supported by jigs mounted upon channel-section beams extending the full length of the machine, which are supported in turn upon the work supports furnished with the cutting machine. The supporting jigs are constructed of ⅜-in. by 3-in. steel bars in skeleton form, the outline being slightly smaller than the contour of the part to be cut. The outline of the jig is within the limits of the finish contour to provide clearance for the cutting stream and the slag of the oxy-acetylene cutting reaction. The material is placed upon these jigs by a labor gang and removable stop keys are provided definitely to locate each stack of material without any adjustment after it has been piled.

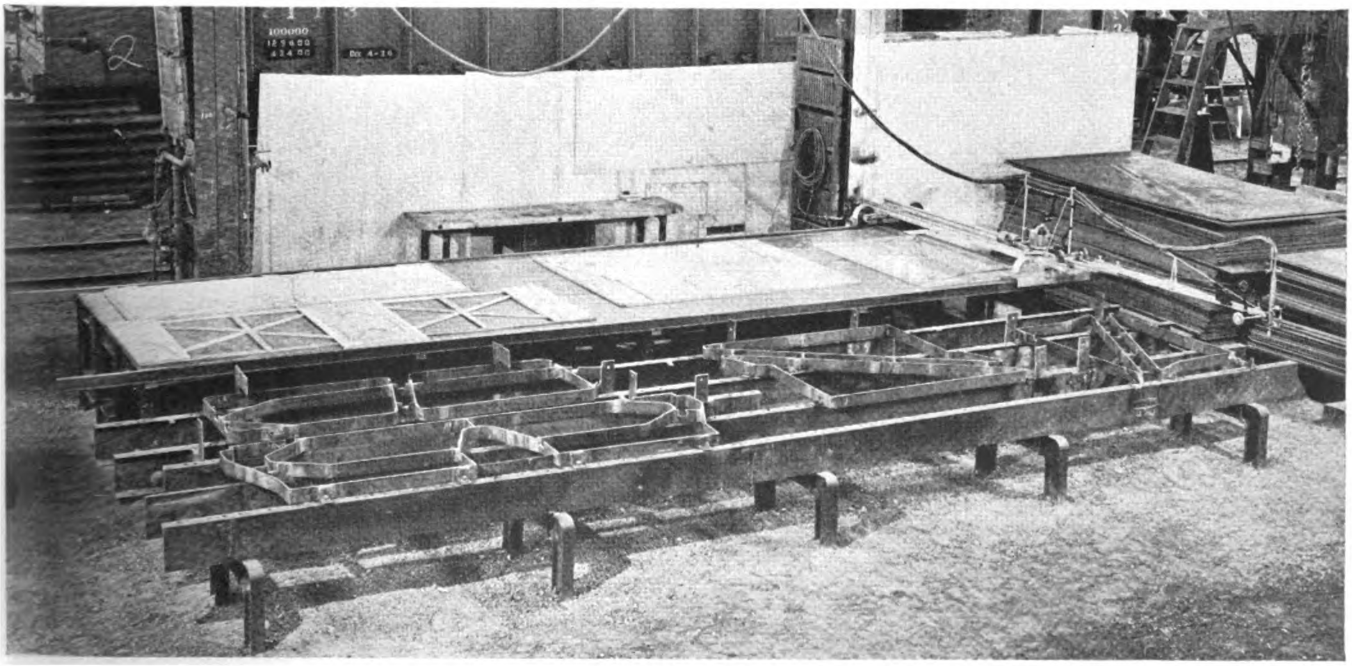
The stop keys are held in place when in use by slots permanently welded to the channel beams. One edge of the slot or keyway is vertical and the other is tapered. With this design, it is not possible for the stop to move out of position and accurate placing of the material at each loading is insured. Provisions have been made to work various sizes of plate stock from the same keyways or slots by making offset keys either extending beyond or receding from the vertical edge of the keyways. All of the keys or stops are identified by markings indicating the specific operation they are to be used on and the location of the stop slot in which they are to be placed. Thus a change of stop arrangement can be made rapidly and no delay in the loading operation occurs.

As previously stated, loading of the plate material is performed by a labor gang consisting of two men who also have the duties of assisting with the unloading of the cut material by overhead crane and separating the cut sheet sections for subsequent handling by punch operators. The labor gang loads the sheets on the jigs from stock piles conveniently located adjacent to them. The sheets are loaded one at a time in order that a visual inspection of the surface condition may be made, the surface can be cleaned and any matter which might prevent bringing the sheets in close contact for the cutting operation can be removed. Sheets or plates having kinked or buckled edges are straightened before being placed in the stacks to avoid separation of the material while cutting. This preliminary preparation has a very definite value, as by careful loading a good, clean cut is obtained without any interruption.

Loading and Clamping the Plates

The sheets are loaded 12 high in our case where material ¼ in. thick is used, the stack thickness being nominally 3 in. Stacking to this thickness has been developed through a careful study during which all factors of time and the cost were considered. With a number of different sheet sizes and with variations in the lengths of cuts to form the various parts, it was found to be most economical to load 12 sheets in order that the loading gang could load progressively ahead of the cutting operation and no delay to the cutting operation would occur.

The material is loaded progressively, that is, the jigs are filled starting at one end of the machine and proceeding to the pig at the opposite end. The loading of the jigs continues, as does the unloading of them, while the cutting operation is being performed and the entire operation becomes a complete cycle of loading, cutting and unloading. As soon as it is possible to do so, the cut stacks are separated by the same labor gang who make certain that there is no adhesion between the cut sections so that they can be easily handled through the subsequent fabricating operations. It might appear



Gas-cutting machine of large capacity with templates in place and material-positioning jigs ready for loading

to some that due to the heat of the cutting reaction, the edges of the sheets might become fused together. This action, it may be assured, does not occur under any condition. With certain improvements which have been made in cutting-nozzle performance, the operation of separating the cut sheets has nearly resolved itself into one of inspection in which it is only necessary to slide the sheets apart to make certain there is no adherence.

To insure close contact between the sheets, pneumatic clamping devices have been erected. These are so designed that pressure can be applied quickly along the line of cut. The pressure is applied through levers moved by fulcrum bars extending along the sides of the work supports. The prime movers are 10-in. by 12-in. brake cylinders operated from the shop-compressed air supply with a pressure of 90 lb. per sq. in. The pressure levers or bars are so designed that they can be easily removed to permit unloading and loading. The labor of removing and applying them is performed by the labor gang.

The operator inspects the stack in order to assure himself that the preparatory work has been properly performed and a good cut will result, after which he applies the clamping pressure. With the pneumatically operated clamps, the pressure is applied quickly and uniformly and the stacks are securely held against the jig forms.

The Cutting Operation

The cutting operation is started immediately after the clamping operation is completed, a single operator handling the machine. The driving mechanism is controlled from the blowpipe end of the machine through a lifting and revolving device. The feed or cutting speed is regulated at the motor through a governor setting and as a constant speed is used for the 3-in. stacks, very little regulation of motor speed is required. With the lifting device, the machine can be moved from template to template from the front or blowpipe end of the machine and there is no need for the operator to move from the normal line of operation to perform this work.

The cut is started at the edge of the stack against the gaging stops and, if continuous, is not interrupted until the cut is completed. In cases where the lines of cut intersect and stop at the point of intersection, gates or switches are provided in the templates and when the cut reaches the point of intersection, it is stopped until the gate can be moved into the proper position. The cut is then resumed by starting through the kerf at the point of intersection of the two lines of cut.

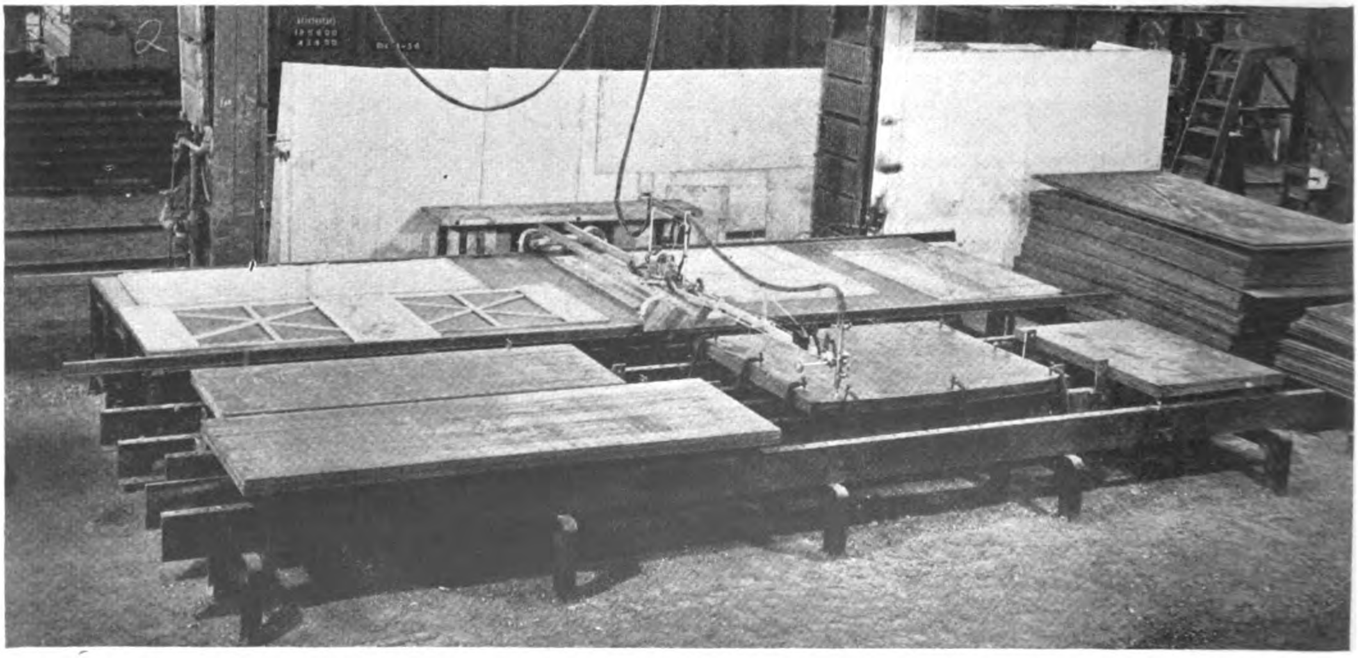
The speed of the machine is so regulated as to give a good smooth cut with the greatest economy. In determining the proper size of stack to be used to obtain the best and most economical results, a great deal of study was devoted to the size of nozzle, oxygen operating pressure and speed of cut, as well as to the loading factor. It was found that greatest economy could be obtained with a 12-plate stack of ¼-in. material which permitted using a medium-size cutting nozzle at nearly top speed for this thickness of material.

Operating Results

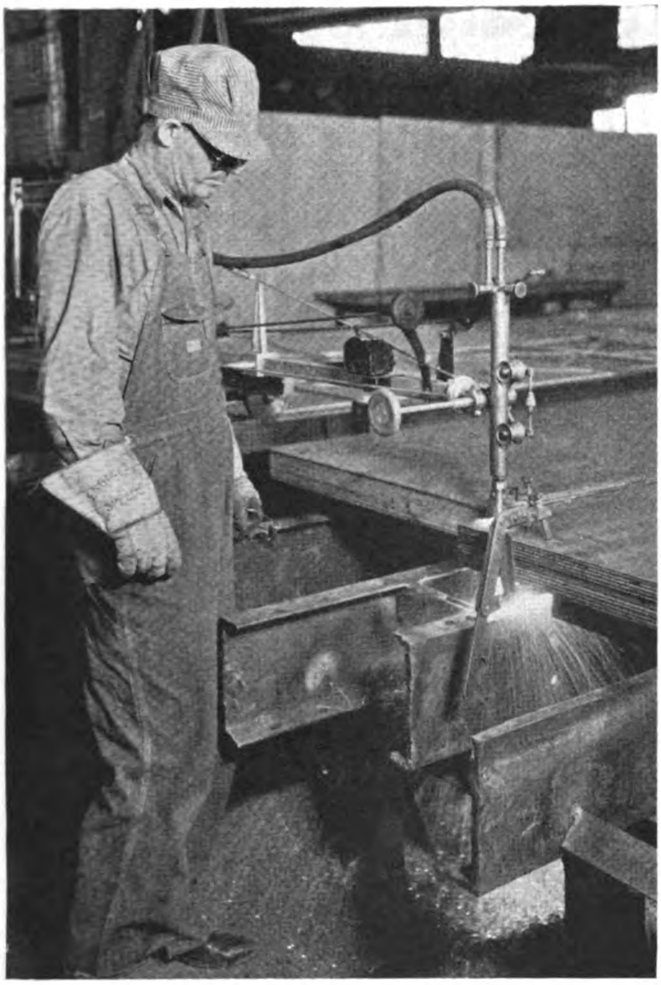
The results obtained through the use of the oxy-acetylene cutting process in stack cutting of freight car parts have fully met the expectations. Cost records which have been carefully made since the cutting machine has entered into full production show an average saving over a 14-day period of 16 per cent in the direct cost as against doing this work by shearing methods. This comparison does not consider any factors of overhead such as maintenance of shearing machines and blades nor power costs, nor does it include the saving effected by reducing the many handlings of this class of material which are required with shearing.

It is evident too that the saving in direct cost will increase as better schedules of supplying the sheet material to the machine and of unloading the finished work are worked out.

There is another factor of importance which must not be overlooked in considering the saving which can be effected through the use of the oxy-acetylene process in the stack cutting of steel sheet or plate material and that is the large saving or earning which is obtained from the recovery of new usable material. With shearing and coping methods, it is not possible to recover much of the waste material removed from the sheets in pieces large enough for use in the manufacture of the smaller parts required in car construction. This is particularly true where recesses are sheared by means of a coping shear, as the material is removed in small bits which go into the scrap bins. The material removed from recesses by



While cutting one stack of material, other stacks are being positioned and clamped ready for the cutting operation



The gas-cutting head completing a long cut in a stack of material

the oxy-acetylene cutting process is in one piece and of such size as can be used for the manufacture of other parts. It is not possible to set up an average figure to represent this saving, due to the variation in the work, but it is recorded that usable material to the value of nearly $200 has been recovered during a six-work-day period at our shop.

In conclusion, it may be well to make a comparison of the quality or workmanship obtained by shearing and by cutting with the oxy-acetylene cutting machine process. When the sheets are cut in stacks by the cutting machine, every piece is identical in contour and this contour can be duplicated over and over. This condition is, of course, not possible when the contour is sheared due to the manner in which the layout is made and the chance that slippage will occur under the shearing action.

With the sheets cut by the oxy-acetylene process, it is only necessary to adjust the gaging stops on the pressing dies once, while it is necessary to make frequent adjustments to take care of the variations caused by shearing.

The edges of the oxy-acetylene-cut sheets are square and full, with no burrs or slivers such as are present on sheets pre-fabricated by shearing methods.

There is a total absence of tearing when the oxy-acetylene stack-cut sheets are formed, due to the fact that the cutting operation does not leave any sharp corners which have high stress concentrations and yield under the additional bending stress of the pressing dies. The radii left at such locations in the sheet contour tend to strengthen this section and provide additional material for the drawing action of the die.

In view of the facts which have been developed through our experience and which have been presented as briefly as possible, it is apparent that the stack cutting of sheet or plate material by the oxy-acetylene process has been a valuable development of the industry.

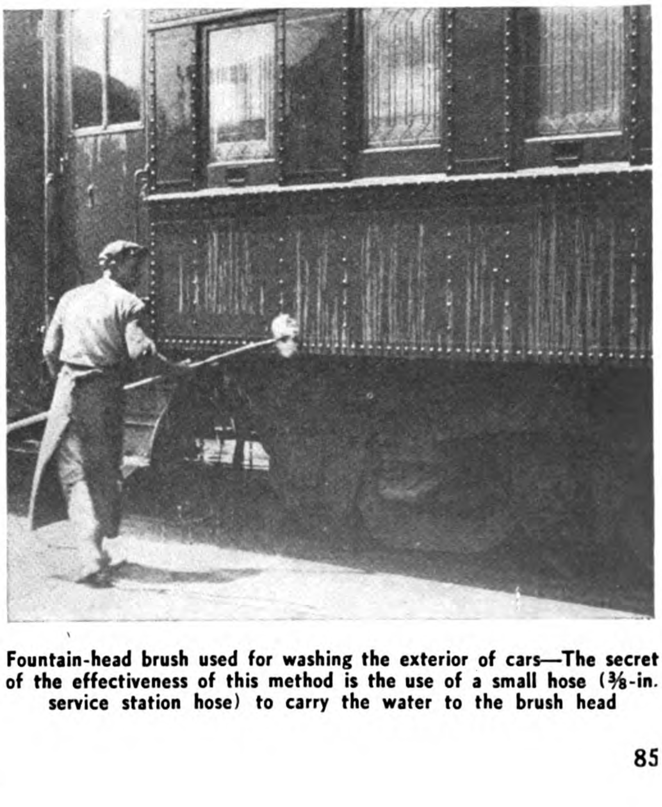
Non-Porous Protective Coating

A line of protective and decorative coatings adapted to application to metal, wood and concrete surface, including passenger cars, locomotives, bridges, buildings, etc., is being offered to the railways by Technical Coatings, Inc., New York City. These coatings, which were developed after several years of laboratory research and extensive service tests, and which have already been applied to many structures, are said to afford a tough, elastic, non-porous surface which will combat corrosion, deterioration and wear over long periods of time. Special features of the coatings, specific types of which are said to be particularly adapted for protecting surfaces subject to corroding gases and brine drip, are in the vehicle employed, which is a specially processed combination of vegetable gums and heat-treated oils, and in the pigments, all of which are metallic in character.

The line of technical coatings includes both primers and decorative top coatings. The primers offered for various conditions of exposure include a zinc metallic coating, an aluminum-zinc coating, and a balanced red lead coating, all of which employ the non-porous vehicle as a base. The top coatings, all of which employ only metallic pigments, are furnished in a wide range of colors, including gray, white, black, buff and green. On order, special colors can be furnished as specified.

All of the coatings are said to have an unusually long life under normal atmospheric conditions, while certain of them are specially recommended for services subject to brine, acids and corroding gases. It is said that tests and actual experience prove that the coatings, in addition to being impervious, adhere tenaciously, and will not crack or peel with expansion and contraction caused by wide temperature changes.

* * *



Fountain-head brush used for washing the exterior of cars—The secret of the effectiveness of this method is the use of a small hose (3/8-in. service station hose) to carry the water to the brush head

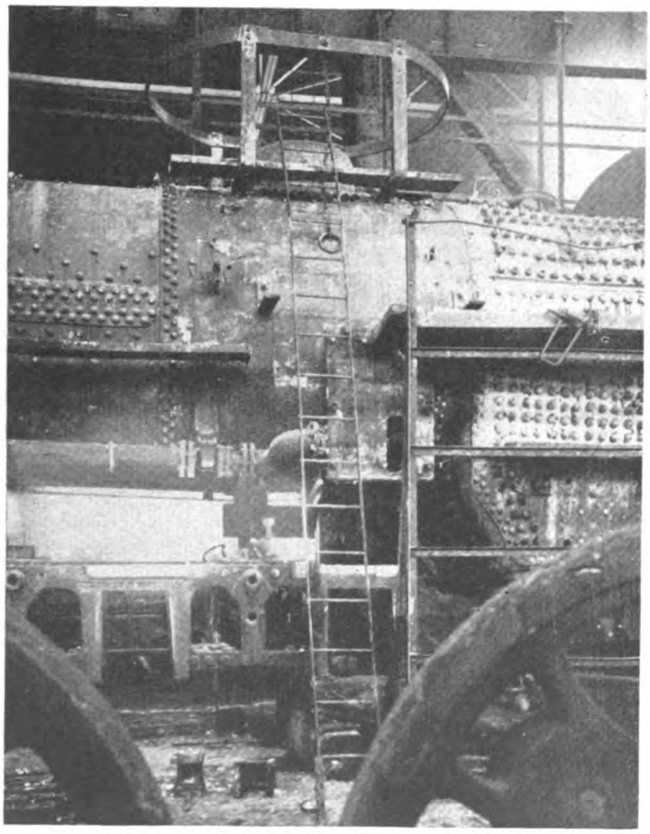
IN THE BACK SHOP AND ENGINEHOUSE

Safety Platform for Dome Work

The illustration shows a substantially-constructed safety dome platform which may be readily applied over the dome of a locomotive undergoing repairs and provide ample protection for workmen who are engaged in making throttle repairs or doing any other work around the steam dome. The upper rail of this protective platform is approximately 7 ft. in diameter and made of 1-in. by 4-in. steel bar stock, being supported on four uprights made of the same material and continuous with the two bottom supports which rest on and are fitted to the curve of the boiler. A plank placed across these bottom supports on either side of the dome affords a secure footing.

The safety dome platform is sufficiently heavy so that there is little tendency for it to slide or slip even when the weight of one or two workmen is concentrated on one side. To serve as an added precaution, however, the actual bearing of the bottom supports against the boiler consists of four 2-in. by 4-in. by 6-in. wood blocks bolted to the supports.

The steel ladder, shown in the illustration, also is more satisfactory than most wooden ladders, being relatively lighter and stronger. This ladder is made of ⅜-in. by 2-in. steel side bars in which ¾-in. round bar steps are inserted and welded, with wood foot pieces bolted to the side bars at the bottom to serve as a bearing against the shop floor and prevent the possibility of slipping.

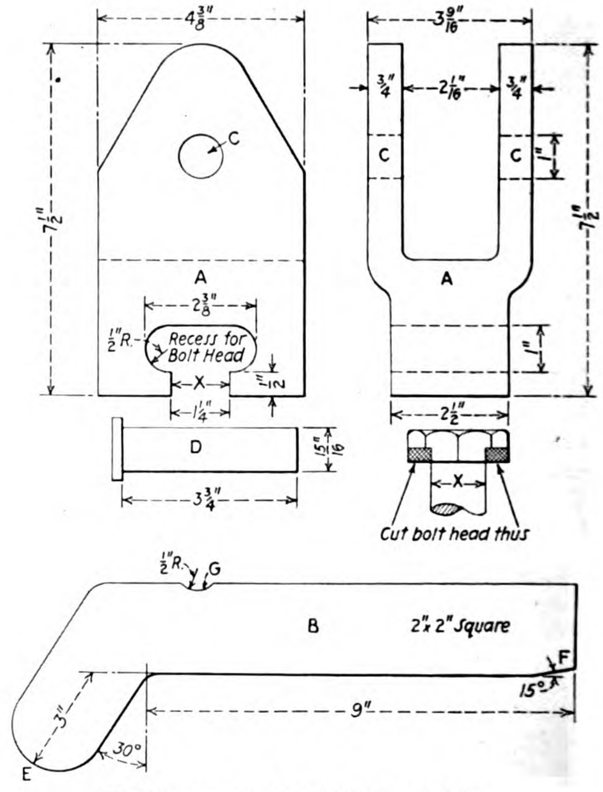


Safety dome platform and ladder used at the Joliet, Ill., locomotive shops of the E. J. & E.

One side of the adjustable safety scaffold, used in connection with boiler work, is also shown in the illustration. This scaffold is 7 ft. long by 44 in. wide on the base and 9½ ft. high to the wood platform. It is made of 2½ in. vertical side angles with horizontal cross angles 1½ in. by 2 in., spaced 24 in. apart. The light guard rail, made of a ¾-in. steel rod, is 22 in. above the 2-in. by 30-in. wood platform which is supported on two steel brackets adjustable for height by means of bolts applied through the vertical side angles.

This adjustable safety scaffold, like the safety dome platform, may be readily moved about the shop by the shop crane and, once suitably placed, contributes both to safety and increased production on the relatively hazardous work on large locomotive boilers. Both devices are successfully used at the Joliet, Ill., locomotive shops of the Elgin, Joliet & Eastern.

Puller for Removing Frame Bolts



Tool for removing locomotive frame bolts

The removal of locomotive frame bolts can be facilitated by the device shown in the drawing. This bolt puller, cut out with an Oxweld automatic shape-cutting machine, places a strain on the bolt head which invariably results in the withdrawal of the bolt. Occasionally it is necessary to sledge the bolt on the opposite end, especially when it seems probable that further application of

pressure on the bolt head may result in pulling the head off the bolt.

The puller consists of a yoke *A* slotted at the bottom to fit over the head of the bolt, and a fulcrum lever *B* for applying the pressure. After the yoke *A* is placed over the head of the bolt, which has been cut away by an acetylene torch as shown in the drawing, the lever *B* is set between the yoke arms and the pin *D* is inserted in the holes *CC*. The ends *E* and *F* of the lever rest on the frame, with the pin *D* in the holes *CC*. The recess *G* keeps the lever in that position. A wedge is then driven under the end *F* of the lever, which is bevelled for receiving the wedge. As the wedge is drawn under the lever, the upward force on the yoke removes the bolt.

Pipe Bushings Made from Extra-Heavy Pipe

It is interesting to know that pipe bushings can be made from extra-heavy and double extra-heavy pipe. The table shows the sizes of pipe, as well as the drill or reamer sizes, to use in making the various bushings. For example, to make a ¼ in. to ⅛ in. bushing, obtain

Table of Drill Sizes for Making Bushings from Extra-Heavy Pipe

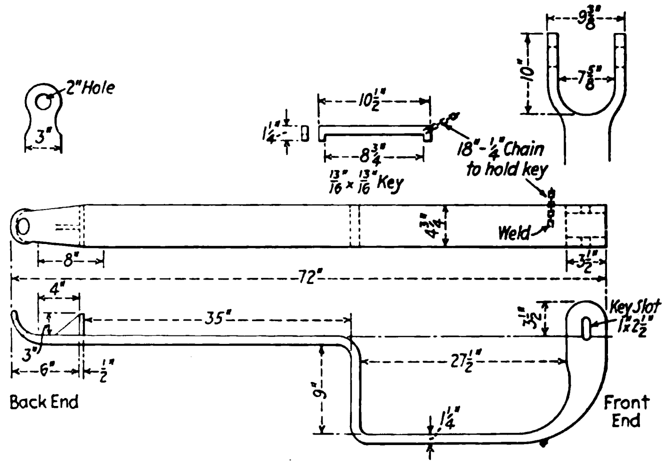
Bushing size, in.	Pipe size to be used, in.	Drill or reamer size, in.
¼ to ⅛	¼, extra-heavy	21/64
⅜ to ¼	⅜, extra-heavy	none
½ to ⅛	½, double extra-heavy	21/64
½ to ¼	½, double extra-heavy	27/64
½ to ⅜	½, double-extra-heavy	9/16
½ to ⅜	½, extra heavy	9/16
¾ to ⅜	¾, double extra-heavy	9/16
¾ to ½	¾, double extra-heavy	11/16
1 to ¾	1, double extra-heavy	29/32
1¼ to 1	1¼, double extra-heavy	1⅛
1½ to 1	1½, double extra-heavy	1⅛
1½ to 1¼	1½, double extra-heavy	1 15/32
2 to 1½	2, double extra-heavy	1 23/32
2½ to 2	2½, double extra-heavy	2 3/16
3 to 2½	3, double extra-heavy	2 9/16
3½ to 3	3½, double extra-heavy	3 3/16
4 to 3½	4, double extra-heavy	3 11/16
4½ to 4	4½, double extra-heavy	4 3/16

a piece of ¼-in. extra-heavy pipe sufficiently long for cutting the outside thread. Then, cut the end off to the desired length, drill or ream it with a 21/64 in. drill or reamer, and tap it with a ⅛-in. pipe tap. In making other bushings the table shows that in the case of the ⅜ in. to ¼ in. bushing the internal diameter of ⅜ in. extra-heavy pipe is such that no drilling or reaming is necessary and that in making ½-in. to ⅜-in. bushings either extra-heavy or double extra-heavy pipe can be used.

Guide Extension for Mounting Crossheads

The mounting of crossheads on two-bar locomotive guides is not usually a difficult task but it is an awkward one because of the links and trunnion frame directly above the back of the guides. This is true even though the crosshead is applied with the aid of a portable crane. This task, however, has been simplified considerably in the Union Pacific shops at Kansas City, Kan., by the guide-bar extension shown in the drawing.

When applying a crosshead, the yoke of the guide-bar extension is set around the bottom guide in front of the guide yoke, and the 13/16-in. by 13/16-in. key is placed in the 1-in. by 2½-in. key slot. The guide-bar extension can then be placed in position on the bottom guide-bar, and when in position, the back end is lowered until it rests on the floor. With the tool in this inclined position, the crosshead is lifted with a portable crane and



Guide-bar extension for mounting crossheads

placed on the guide-bar extension, allowing it to slip down until it rests against the small angle welded on the back end of the tool.

The back end of the guide-bar extension is then raised with the portable crane until it is level with the guides, after which the crosshead is shoved forward onto the guides either by hand or with a bar. Obviously the 4¾ in. width and 35 in. length of the crosshead seat of the bar shown in the drawing can be changed to suit dimensions of different classes of engines.

Taper Cutting Die Head

A heavy-duty taper-cutting die head for handling threads of large diameters, steep tapers, and extra lengths, has been added to the line of die heads manufactured by the Landis Machine Company, Waynesboro, Pa. Known as a special 6-in. Landmatic, it augments the line of Landmatic die heads with taper attachment previously manufactured in sizes up to 4 in. The head is of the six-chaser type and was designed for threading parts such as tool joints and drill stems.

This head is of the stationary type adapted for use on a heavy-duty turret lathe. An adjustable bar, mounted on some stationary part of the machine, retards the cam carrier as the head advances onto the work. The adjustable bar is set to have contact with the cam carrier just as the part to be threaded enters the die. The sliding movement of the cam along the cam shoe allows the chasers to recede at a uniform rate and produces a tapered thread corresponding to the taper of the cam. The head opens automatically when the cam trips off the end of the cam shoe.

Before the head is closed, the carriage must be returned a sufficient distance in order to clear the stop bar. The adjustment for thread length limits the forward travel of the cam carrier and insures threads of uniform diameter and length.

This die head can be supplied for cutting various

(*Continued on page 92*)

EXPERIENCE IS A GOOD TEACHER

"THE man should be taken out of service!" Master Mechanic Carter of the Plains Division on the S. P. & W. hit the desk with his clenched fist so hard the onyx desk set almost jumped off. The master mechanic slid the desk set back to a safer place. It was a Christmas gift from Mrs. Carter. He didn't dare get it broken so soon after Christmas.

"We can't put up with that kind of work, I tell you, and the only way to stop it is pull a few men out of service," Carter continued.

"But Mr. Carter," Jim Evans, the roundhouse foreman at Plainville said mildly, "perhaps it's not altogether Clark's fault that the rod bushing pounded out."

"The engine was out of tram, wasn't it? Clark put it up, didn't he?"

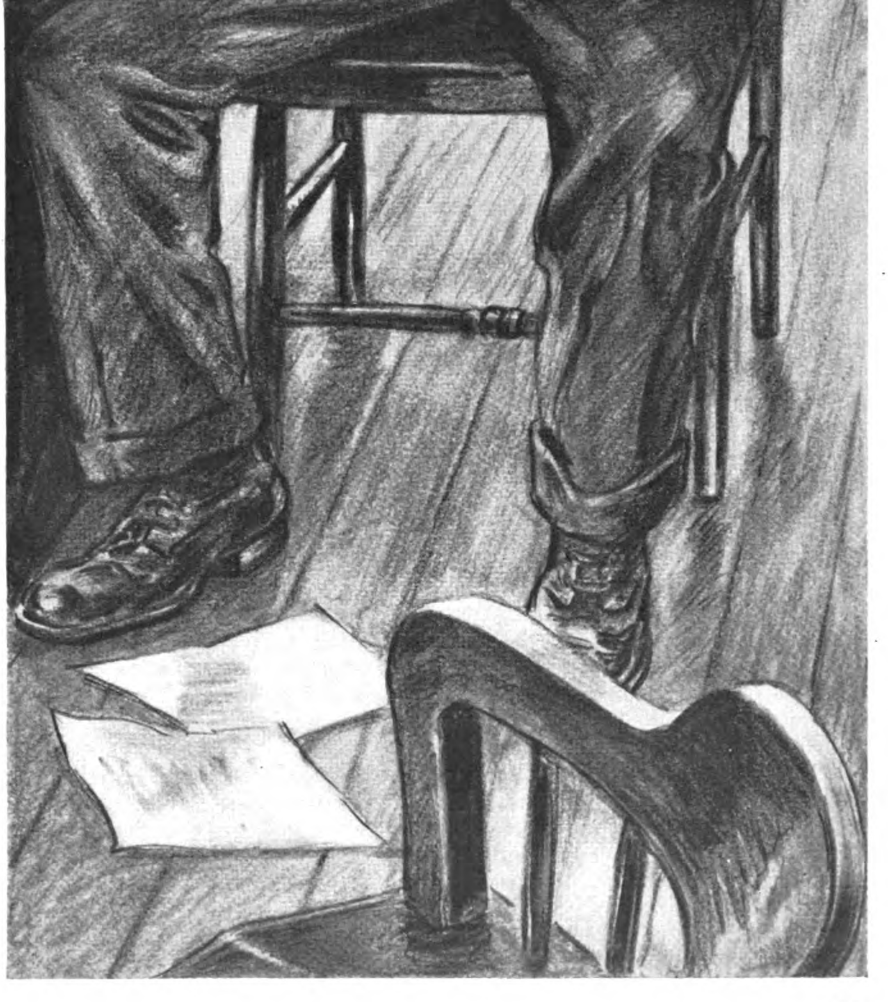
Evans shifted his chew of "horseshoe" to the other cheek. "Yes, that's true; the engine was out of tram and Clark put it up."

"He's a machinist, ain't he? Served his apprenticeship, didn't he?" Carter started to pound the desk again, looked at the elaborate fountain pen holder, and changed his mind. "We pay him machinist's wages! It's not our fault if he is not able to do a machinist's work."

"I'm not so sure about that," Evans disagreed courteously. "It's true Clark served his time, most of it right here in Plainville, but he didn't learn the trade and I wouldn't say it's entirely his fault. The same thing applies to Goodwin and Niles. All three started on their time together. None of the three could be called all-around mechanics. Clark is a good machine man, none better in the shop; Goodwin is a good air man; and Niles can wheel an engine and put up the rods quick as any man on the job. But, take them off their specialty and none of the three could be called good."

"It's not our fault if they didn't learn the trade!" Carter raised his clenched fist, then stuck his hand in his pocket.

"Don't think I'm trying to argue with you, Mr. Carter. I know your disposition to be fair. That was a rotten job Clark put up on the 5070; it's a wonder she didn't jerk all the rods off, the wheels were so badly out of tram. But, if you are willing to take the time, I believe I can show you where we are equally responsible for the failure."



"We can't put up with that kind of work, I tell you, and the only way to stop it is to pull a few men out of service," Carter continued

by
Walt Wyre

"All right, I'm willing to be shown," the master mechanic replied. "Go ahead."

"Remember the day those three boys started out as apprentices?" Evans began.

"Yeah, it was back in 1929," Carter replied. "Things were booming then."

"Well, let's start there"—and Evans gave him the story. . . .

BUSINESS was good in the spring of '29. When the cantaloupes started moving along in May, the Plains Division was handling thirty to thirty-five trains a day.

There was a shortage of power, both man and motive. Overtime was accepted as a necessary evil incidental to conditions. Mechanics looking for jobs were as hard

to find as Republican votes at last November's election.

"I have authority to put on some apprentices," Carter told Evans one day. "Who would you recommend?"

Evans named over half a dozen likely boys, sons of employees, that he thought would, with proper training, make good mechanics. Clark, Goodwin, and Niles were accepted. The master mechanic called the boys in the office and gave them a lecture. After the boys signed their indentures, he gave them some more advice.

Next morning at eight o'clock, the new apprentices came to work together. All were dressed alike in new overalls and spotless, blue polka-dot caps. The three boys stuck together like three lost chickens in a rainstorm until Evans had time after eight o'clock to assign them to their respective jobs. The foreman had talked with the three boys previously about where they preferred to start. Clark was placed in the machine shop, Goodwin started at the air bench, and Niles began at the drop-pit.

At the end of six months, each of the three boys could do a fair job of the particular class of work they had been doing. The work was still new enough not to be monotonous. Each of the apprentices, at their own request, were allowed to remain longer on the same jobs on which they had started. Two months later, when the fall slump hit, it was a case of be laid off or go to the back-shop. They chose the back-shop. Clark, at his own request, went in the tool room; Goodwin continued his work on air equipment; and Niles was pleased by being assigned to a job on the floor of the erecting shop.

At first the shop worked full time. Two evenings a week the boys, together with thirty-odd other apprentices, attended an apprentice class where they studied drafting, practical mathematics, and other essential subjects. The apprentice class was just getting into the study of valve motions when the shop closed down. When it reopened three months later with reduced force, the apprentice instructors were not called back. The apprentice school was no more for lack of an appropriation.

The apprentices were put on various jobs, but somehow the desire to learn was not as keen as before. What's the use, they reasoned, of learning a trade only to be cut off when the apprenticeship is finished. Thousands of mechanics were walking the streets looking for jobs, waiting and hoping for the elusive corner around which prosperity was said to be hiding.

The back-shops worked spasmodically as current finances would allow; some months, ten days; some, twenty; others, not at all. Some apprentices quit, hoping to find jobs with brighter looking futures. The three from Plainville stuck, more from lack of opportunity at something else than otherwise. At least it was a job that would keep them fed and clothed for the time being. What if they were cut off a large part of the time? That only postponed the date when they would finish their time and join the army of unemployed mechanics walking the streets.

So the boys worked on sans enthusiasm, sans inspiration, thinking mostly of quitting time and payday and how to fill the time between with as little inconvenience as possible.

The rows of technical books in the back-shop library accumulated a coating of dust. Subscriptions to journals of the trade were allowed to expire without being renewed. Correspondence courses were forgotten by most of the apprentices that had taken them out.

And so the time dragged on until in 1933 the back-shop closed down indefinitely. Clark, Goodwin, and Niles, more fortunate than many others, were allowed to return to their home point to continue the trade. When the apprentices returned to Plainville, Evans made a conscientious effort to see that the boys had an opportunity to learn the trade. Clark was placed at the air bench, Goodwin went on the drop-pit, while Niles went in the machine shop.

THE 5084 was undergoing Class 6 repairs and was about due off the drop-pit. As usual, Evans was short of power when the despatcher called and said he would need an additional engine next day. The 5076 burst a siphon.

"Well, the only thing I can see is run the 5082 on the extra and get the 5084 out for the east local," Evans told John Harris, the clerk.

"Can you get her out without overtime on her?" Harris inquired.

"Have to!" The foreman was emphatic. "They'll raise more hell about an hour overtime than twin boys with one bicycle." Evans bit off a hunk of "horseshoe" and headed for the roundhouse.

"Have you got the rod bushings finished for the 5084?" he asked machinist Cox.

"No, been tied up on running repair." The machinist indicated a stack of brasses to be turned that meant it would be some time before he could get around to the dead work.

Evans scratched his head and walked over to where Niles was going through the motions of operating a lathe. "Think you can make the bushings for the 5082?" the foreman asked.

"I think so," the apprentice replied.

"All right, take your time and see that they fit. I've got to run the engine on the east local in the morning," Evans said.

Niles went to work on the bushings. Goodwin, working with Jenkins on the drop-pit, was putting up the wheels. Evans told them of the necessity for finishing the engine.

Just before five o'clock, Goodwin started the left main bushing in. The bushing refused to go. He hit it several blows with an 8-lb. sledge. About half way in the bushing stuck again. Cox, busy on the other side of the engine, was paying no attention to the apprentice.

'Bushing sems a little tight," the apprentice yelled to Cox.

"Did it start all right?" the nut-splitter asked.

"Yeah," Goodwin replied, "but it go tight after it started."

"Well, maybe it's in a cramp. Hit it a couple of licks," Cox told the apprentice.

Goodwin hit it two or three times with the sledge. The bushing moved a little, but too slowly to suit him. He spied a heavy ram that had been used for driving in a main pin. "Hey, gimme a hand," he yelled to two laborers nearby.

The ram did the job. Half a dozen blows and the bushing was in and tight as the cork in a Scotchman's bottle.

In the meanwhile, machinist Martin and apprentice Clark were finishing connecting up the air equipment in the cab. Clark assembled the brake valve and placed it on the pedestal.

When the five o'clock whistle blew, the fire-builder had a fire going and the steam gage needle was beginning to quiver at the peg.

"We'll let the night men finish her up," Evans said.

Next morning when the foreman reached the roundhouse at seven o'clock, the 5084 was setting out on the lead ready for the local and called for 8:15. The foreman had just finished distributing the work slips when

the engineer blew three lusty blasts with the whistle of the 5082. A moment later the whistle again tooted insistently. Evans almost collided with the outbound inspector at the roundhouse door.

"Something wrong with the air on the 5084!" the inspector panted.

"What seems to be the trouble?" Evans asked.

"Don't know. It acts crazy," the inspector replied.

"Get Martin on it, right away," Evans said.

After a twenty-minute search the machinist decided the trouble was in the air-brake valve. The rotary valve had been turned just half around and the handle put on with the valve in that position. The engine was delayed thirty-five minutes.

Seven miles out of town the acrid odor of burning grease reached the engineer's nose. When he stopped the train, the left main pin was stinking hot. The back end of the main rod was beginning to turn blue from the heat. The hoghead cooled the hot brass, forced in some fresh grease and the engine made it to the next station four miles away, but not until the pin was so badly cut that it would require more than a new brass to put it in condition for another trip.

Evans used every cuss word he knew and made up some new ones for the occasion. He called the three apprentices in the office to talk to them.

"That's rotten work," Evans told the apprentices. "Rotten! How do you ever expect to be mechanics turning out jobs like that?"

The boys shuffled uneasily, looking at the floor, then Goodwin spoke up. "How can we ever expect to be mechanics, anyway? With thousands of machinists walking the streets, we can't expect to get a job when we finish our time."

"That's the way it looks now," Evans agreed, "but maybe things will get better by the time you finish."

"It's not likely," Clark said, "besides, we're not learning anything, not much, anyway. We're just serving a sentence with pay. The company is not trying very hard to teach us anything. I guess we just got a little disinterested," the apprentice added apologetically.

"What do you have to say, Niles?" Evans asked.

"Well, I'd rather be on the drop-pit than running a lathe. 'Course, I guess, the reason is that I've had more experience on the drop-pit and it's easier for me. I know I need the machine shop experience if I'm ever going to be a machinist, but being as there's mighty little chance of me getting a job when I finish, I'd rather be doing something that I can do." Niles sighed deeply as though relieved of a terrible load.

"Me too," Clark said. "I'd rather be running a lathe than fiddling around at that air bench."

"Well, I'd like to get off the drop-pit," Goodwin said.

Evans scratched his head thoughtfully. There was some logic in what the apprentice had said. At the same time, according to the agreement, apprentices should be given an opportunity to learn all branches of the trade and the time divided so as to give them the chance. The railroad would get more and better work with the men assigned to jobs they could do best.

"I'm going to put you boys on the jobs you prefer, starting in the morning. When you get ready to pitch in and learn the trade, I'll shift you around again."

The three apprentices finished their time working almost all of it on the jobs they had started out with. True to expectations, there were no jobs available when they finished. They worked at various and sundry jobs until in the fall of '36 the S. P. & W. began putting on men. The ex-apprentices were called in and given jobs. At first all three were on nights. Business picked up still more. Locomotives that were long overdue shopping had to have lots of work on them to keep them moving and additional mechanics were put on. Clark and Goodwin went on days. Clark managed to get a machine job, while Goodwin was forced to go on the drop-pit.

THEN one day Evans received a letter from the master mechanic saying that the allowance had been reduced. Working time had to be cut down. After a conference with representatives of the various crafts, it was decided to reduce the force on Saturdays and Sundays rather than cut off men.

"How'll we decide who'll work and who will be off?" Evans asked.

"That's easy," the machinist representative replied. "Just start at the top of the seniority list and take as many men as you need to work on days forces are reduced. The ones next on the list will work next time, and so on."

"Just keep rotating the men in order," the foreman said.

"That's the idea exactly," the machinist representative replied.

The others agreed that was fair and the method was adopted.

"How's the allowance coming?" Evans asked Harris, the clerk, on Thursday.

"Running over bad," the clerk replied.

"Well, we're just going to have to cut down more Saturday and Sunday," Evans said. "I don't see how we can get by, but the master mechanic says we've got to stay in the allowance."

SATURDAY morning the roundhouse force looked like a prayer meeting crowd on bank night at the picture show. Only four machinists were working, Clark, Goodwin, Martin, and Hill. Evans had the men lined up working only jobs that were absolutely necessary. He had it all figured out to get by in fairly good shape when the clerk found him at the board in the roundhouse.

"Despatcher says there'll be two extras east this evening and probably two sections of No. 10," the clerk said. "What'll I tell him?"

"Tell him that locomotives come twelve in a can and we'll have a fresh dozen if he'll send up the can opener." Evans' teeth snapped on a plug of "horseshoe." "I'll let him know soon as I can figure it out," the foreman added and started to the office.

"Now let's see," Evans mused, "I can let him have the 5081. It should be O.K. to go. The 5076 will be in on 71. What time's 72 doped to get in?" he asked the clerk.

"Ought to be in now," the clerk replied. "It's figured to be here at 9:40."

"Well, that's that! Tell old guess-and-grumble it'll be the 5081 and 5076. If they run two sections of No. 10, I'll figure that out later."

No. 71 rolled into town a few minutes later.

"Look her over quick as you can and tell the hostler I said to get her in the house soon as possible," Evans told the inspector.

The inspector climbed up in the cab of the engine. He glanced at the cab card, then looked again to be sure. "She's due for an annual," the inspector called out.

"What!" Evans' mouth dropped open like a trap door. He climbed up in the cab and looked at the card hoping the inspector was mistaken. He wasn't.

Evans climbed down from the cab of the engine and headed for the roundhouse like a man taking an out-

bound ticket to his mother-in-law. He made the round through the house—not another extra engine. If No. 10 ran in two sections, he could possibly use the engine that came in on the first one for the second, but that wouldn't help any for the two extras. They would run before the passenger was due in.

Not a chance of making an annual on the 5076. Evans passed the 5070 standing on the drop-pit. The engine was due out Monday. It would take less time to get the 5070 ready than it would to make an annual. He sent Clark and Goodwin with their helpers to the drop-pit.

"Throw your feet out, fellows, and get her finished soon as possible. I'll tell the fire-builder to fill her up and get a fire in her right away."

The men worked, no argument about that. At 6:30 the engine was ready to run out of the house. The second extra was called for 8:15.

An engine can be expected to run a little hot coming right off the drop-pit. To offset that, Evans gave instructions for extra grease to be put on the engine and for the rod cup man to take particular care to see that every bushing had plenty of grease. But grease doesn't do much good when the wheels are out of tram, at least as badly out as the ones on the 5070 Something had to give way. Fortunately it was brasses instead of rods. The trainload of cattle was delayed seven hours waiting until another engine could be sent to take the train on.

"Well, what are we going to do about it?" Carter asked when Evans had finished.

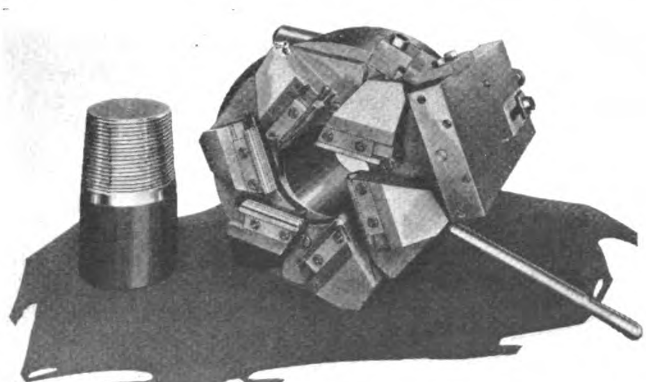
"There's one thing we can do, at least," Evans replied. "We can let this be a lesson. When we have apprentices learning a trade we can see that they learn it instead of taking the easy way out. We might need those same apprentices as mechanics some day."

Evans reached for his plug of "horseshoe" as Carter began fiddling with some papers on his desk.

Taper Cutting Die Head

(*Continued from page 87*)

diameters, tapers, and thread lengths. It was primarily designed for cutting threads of 6 in. outside diameter, 4 pitch, 2 in. taper per ft., and 5 in. length. The same

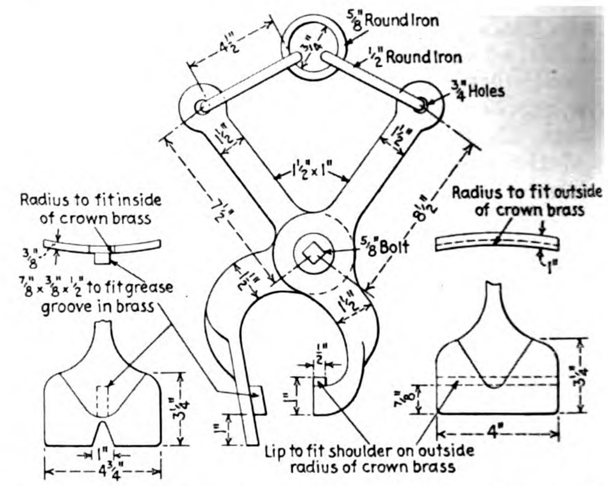


Landmatic 6-in. taper cutting die head

head can also be adapted for cutting threads of 5½ in. outside diameter, 4 pitch, 3 in. taper per ft. and 4¾ in. length; and threads of 4⅝ in. outside diameter, 4 pitch, 3 in. taper per ft., and 4 in. length.

Lifting Tongs For Crown Bearings

The weight of driving-box crown bearings often necessitates the use of some kind of a lifting device preparatory to pressing these bearings into the boxes. The tongs shown in the drawing are in use on one road for handling crown bearings weighing from 194 to 350 lb. each. These bearings are cast with a grease groove on the inside and a collar or flange on the outside. After



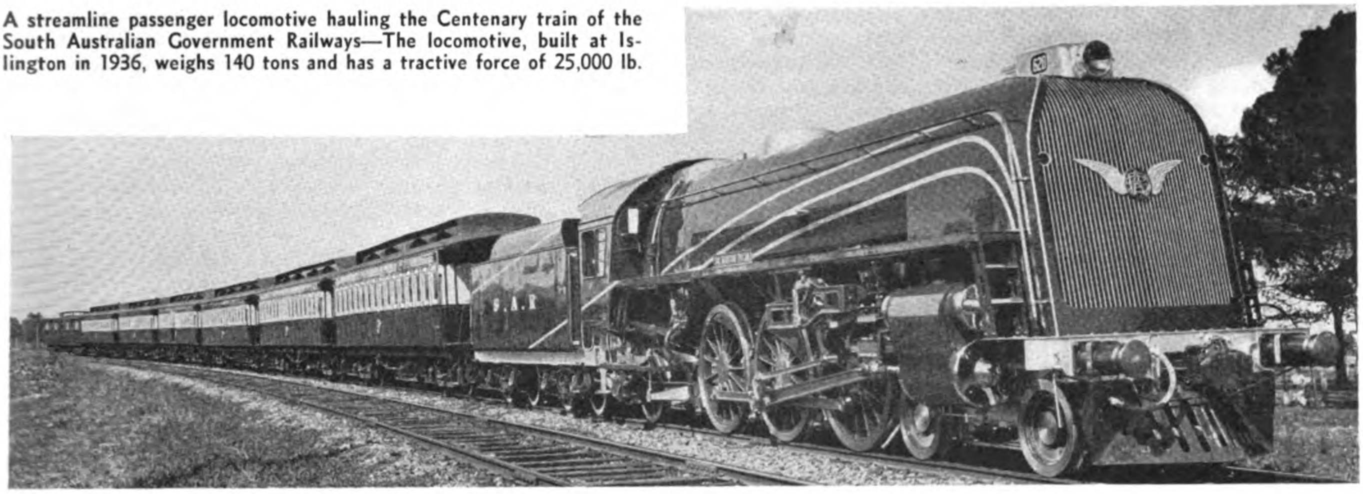
Tongs for lifting heavy crown bearings during pressing operation

the crown bearing has been turned to size with a collar ⅜ in. high and then planed to fit the driving box, the tongs are then used with a hoist to lift the bearing up so it can be pressed into the box. It will be noticed that one leg of the tongs is provided with a lug to enter the grease groove while the other leg is made with a lip to catch under the turned collar of the bearing. Although some roads do not turn bearings with a collar, most all of them have the grease groove, thus permitting the use of tongs similar to the one shown.

Electrode for Small A.C. Arc Welders

The Wilson Welder and Metals Company, 60 East Forty-second Street, New York, has developed an electrode for use with small transformer-type a.c. arc welders. Although designed specifically for use with a.c. arc welders, this Wilson No. 520 electrode, as it has been designated, is said to be equally well adapted for d.c. machines. Tests are reported to have shown that the electrode deposits a smooth bead with slag interference reduced to a minimum. Heretofore, the welding performance of these small machines has been somewhat hampered due to an unstable arc caused by the alternating current. The No. 520 rod was developed to overcome this difficulty.

UNUSUAL HOBBY.—Railroad lantern collecting is the unusual hobby of a New Britain, Conn., man, who has 90, representing 40 railroads from New England to the Middle West. He has found them along railroad tracks, in attics, cellars, antique shops, and junk heaps. Two date back to 1860, one used by the Adams Express Company and the other from the New York, Lake Erie & Western.



A streamline passenger locomotive hauling the Centenary train of the South Australian Government Railways—The locomotive, built at Islington in 1936, weighs 140 tons and has a tractive force of 25,000 lb.

NEWS

I. C. C. Declines to Dismiss Power Reverse Gear Case

The Interstate Commerce Commission on January 11 denied the petition filed by the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen for a dismissal of their complaint in the power-reverse gear case, because an agreement had been reached with the railroads on a plan for equipping locomotives with the power gear. The commission gave no reason for its denial but it was assumed that it desired to make a report following its long hearings in the case.

Burlington Zephyrs Pass Two-Million-Mile Mark

Coincident with the arrival in Chicago and Denver on January 26 of the 12-car Burlington Zephyrs, the total mileage operated by the Burlington's fleet of eight streamline stainless-steel trains reached the two million mark. At the same time the 500,000-mile mark was passed by the two Denver Zephyrs.

First place in total mileage for individual Zephyrs goes to one of the former Twin Zephyrs, now the Ozark State Zephyr, operating between St. Louis and Kansas City, which has to its credit a total of 515,041 miles. The other small Twin, rechristened the Sam Houston, operating between Houston and Dallas, is credited with 508,938 miles. The pioneer Zephyr, operating between Lincoln and Kansas City, Mo., via Omaha, has an aggregate of 463,330 miles.

The James F. Lincoln Arc-Welding Foundation

To Stimulate intensive study of arc welding $200,000 will be distributed by the James F. Lincoln Arc Welding Foundation among winners of 446 separate prizes for papers dealing with arc welding as a primary process of manufacture, fabrication or construction in eleven major divisions of industry. The principal prize winner will receive not less than $13,700. Other prizes will range from $7,500 to $100, the latter sum to be awarded to each of 178 contestants who receive no other prize, but whose papers are adjudged worthy of honorable mention.

Among the eleven major divisions of industry eligible in this contest are the railroad field, the automotive field, the structural field and functional machinery. In the railroad field twenty-four prizes, with a total value of $14,200, will be awarded for the best papers on locomotives, freight cars, passenger cars, or locomotive and car parts.

The contest will close June 1, 1938. For complete details of the rules and conditions covering awards communicate promptly with the foundation secretary, A. F. Davis, P. O. Box 5728, Cleveland.

Institute for Social Progress

"The World Challenge to Democracy—How Can America Meet It?" is to be the subject for discussion at the two weeks' Summer Institute for Social Progress to be held on the campus of Wellesley College, Wellesley, Mass., July 10 to 24. The point of view of mechanical engineers in the railway world is desired in the cross-section membership of the Institute and those men and women interested in the possibility of attending should write to G. L. Osgood, 14 West Elm avenue, Wollaston, Mass., for details and membership blanks. Dr. Colston E. Warne of the Economics Department of Amherst will lead in the discussion.

Charles A. Gill Honored

About 350 friends and well wishers of Charles A. Gill, recently made general manager of the Reading and Central Railroad of New Jersey lines, gave a dinner in his honor at the Berkshire Hotel, Reading, Pa., on the evening of January 18. Special trains were run to carry guests between both New York and Philadelphia and Reading. After-dinner talks were made by President E. W. Scheer of the Reading; Vice-President C. W. Galloway of the Baltimore & Ohio; Vice-President R. W. Brown of the Reading; Judge H. Robert Mays of Berks County, Pa.; C. A. Dana, president, Spicer Manufacturing Company; Roy V. Wright, editor, *Railway Mechanical Engineer*; D. W. Pye, president, Tuco Products Corporation; Arthur N. Dugan, vice-president, National Bearing Metals Corporation; George DeGuire, president, Ajax Hand Brake Company, and John O. Haines, president of the Reading Company's Booster Committee. General Superintendent P. S. Lewis, of the Reading, acted as toastmaster, and during the dinner several numbers were rendered by the Reading Company Glee Club. President Scheer, on behalf of the group, presented Mr. Gill with a star sapphire ring. Mr. Gill was recently elected president of the New York Railroad Club.

Equipment Building and Betterment Program

The *Baltimore & Ohio*, on January 20, authorized the purchase of 2,000 gondola cars of 70 tons' capacity (1,450 of 52½ ft. and 550 of 65½ ft. length), and also the construction of 2,000 covered-wagon-top box cars, of 50 tons' capacity and 42½ ft. in length, in the company's shops. The construction of the 2,000 box cars in the company's shops will give employment to a large number of its employees throughout the remainder of the year. The total estimated cost of this equipment is approximately $10,000,000, the financing of which it is expected will be arranged through an equipment trust. A contract has been let to the Bethlehem Steel Company for 1,500 gondola cars, as noted in the new equipment table elsewhere in this issue.

Boston & Maine.—Fifty-five additional air-conditioned, deluxe passenger coaches will be placed in service by the Boston & Maine and the Maine Central as a part

of a $1,820,000 new equipment and materials order just placed by those roads.

The Pullman-Standard Car Manufacturing Company at Worcester, Mass., will build 20 new air-conditioned coaches for the Boston & Maine (as was reported in the January issue of the *Railway Mechanical Engineer*), at a cost of $40,000 each. These coaches will be of the 84-seat type with the latest appointments. Thirty of the present B. & M. all-steel coaches will be modernized, air-conditioned and have new de luxe seats and modern flooring and lighting installed at the B. & M. shops at Concord, N. H., and five all-steel coaches of the M. C. will be similarly modernized at its shops at Waterville, Me.

The re-conditioned coaches from the shops of the two railroads will commence to go into service in the spring, and the new cars from Pullman-Standard are expected to be ready for service this summer. Both the new and the re-conditioned deluxe coaches will be decorated in various color schemes, with the re-conditioned coaches being finished and upholstered in blues and browns. The new coaches will have an entirely new color scheme.

The orders also include 6,000 tons of rails and accessories for the Boston & Maine and 3,500 tons of rails and accessories for the Maine Central.

Canadian Pacific.—This road is carrying out a large air-conditioning program at its Angus shops in Montreal, according to an announcement by D. C. Coleman, vice-president of the company. A total of 136 cars including standard sleepers, dining cars, tourist sleepers, parlor cars and day coaches will be air conditioned. Having previously carried out similar work on 130 cars in 1936, this road upon completion of its new program, will be in a position to greatly extend its air-conditioned services throughout the Dominion.

Chicago, Milwaukee, St. Paul & Pacific.—The federal court at Chicago, on January 21, approved a petition of the Milwaukee's trustees to make application to the Interstate Commerce Commission for authority to finance 75 per cent of the cost of constructing new equipment with equipment trust certificates. The cars to be constructed in company shops during 1937 include: 500 fifty-ton steel hopper cars; 500 fifty-ton automobile cars; 7 dining cars; 1 mail-express car, and 5 coach-baggage cars. In addition, the court was asked to approve the construction in company shops of 1,000 gondola cars and 22 air dump cars.

Central Vermont.—At the St. Albans, Vt., shops of the Central Vermont, nearly $250,000 in outside repair work to locomotives and freight cars has been assigned for this year, according to an announcement made by Edmund Deschenes, vice-president of the road. This includes 15 locomotives from the Grand Trunk lines in New England for general repairs and 100 of the Canadian National's American-owned coal cars. About $8,000 will be spent on each locomotive and $1,200 on each coal car; a total repair bill of $240,000, one-half of which will represent labor costs, the remainder being for material. The Grand Trunk-Canadian National repair work is in addition to the regular Central Vermont work at the St. Albans shops. The Grand Trunk-Canadian National plans to air-condition, completely, trains operating over the Grand Trunk through local cities and eastern Canada.

Missouri-Kansas-Texas.—The M-K-T will spend approximately $5,000,000 for 1,279 freight and passenger cars, inquiry for which was reported in the January issue of the *Railway Mechanical Engineer*, and $10,000,000 for track and equipment maintenance. Locomotive shops at Waco, Texas, and Parsons, Kan., are now working with full-time crews on an extensive motive power repair and rebuilding program.

New York, New Haven & Hartford.—The trustees of this road on January 15 filed a petition in the United States District Court requesting authority to acquire 50 additional light-weight air-conditioned passenger coaches of the very latest type, and 5 modern cafeteria cars. The road recently placed in service substantially all of the 50 passenger cars authorized last March, but increased passenger traffic now requires additional coaches. The cost of the new coaches is estimated at $40,000 each, and of the cafeteria cars $45,000 each, to be financed in part by payments of cash and by means of an equipment trust.

New Equipment Orders and Inquiries Announced Since the Closing of the January issue

Locomotive Orders

Road	No. of locos.	Type of loco.	Builder
C. & I. M.	2	0-8-0	Lima Loco. Wks.
Guayaquil & Quito (Brazil)	2	2-8-0	Baldwin Loco. Wks.
New Orleans Public Belt	3	900-hp. Diesel-elec.	Baldwin Loco. Wks.
Nor. Pac.	9	4-6-6-4	American Loco. Co.
Union Pac.	25	4-6-6-4	American Loco. Co.

Locomotive Inquiries

Road	No. of locos.	Type of loco.	Builder
Aluminum Co. of America	1	2-8-2	
Mo. Pac.	6	Diesel-elec. switch.	
Nor. Pac.	8	4-8-4	

Freight Car Orders

Road	No. of cars	Type of car	Builder
B. & O.	1,500[1]	Gondolas	Bethlehem Steel Co.
C. & N. W.	200	70-ton hoppers	Pullman-Std. Car Mfg. Co.
Illinois Central	500	Auto. box	Pullman-Std. Car Mfg. Co.
	500	Auto. box	American Car & Fdry. Co.
	800	Auto. box	Gen. American Trans. Corp.
	300	Refrigerator	Gen. American Trans. Corp.
	500	Hopper	Pressed Steel Car Co.
	500	Hopper	Ryan Car Co.
Ill. Terminal	100	50-ton mill type gondolas	Mt. Vernon Car Mfg. Co.
	50	50-ton flat	Mt. Vernon Car Mfg. Co.
St. L.-S. F.	600	Box	Company shops
	250	Hopper	
	20	Caboose	

Freight Car Inquiries

Road	No. of cars	Type of car	Builder
Mo. Pac.	700	50-ton gondolas	
	1,000	50-ton box	
	500	55-ton hopper	
	300	50-ton flat	
	25	30-ton caboose	
N. C. & St. L.	500	Box	
North American Car Corp.	200	40-ton refrigerator	
Nor. Pac.	750	50-ton gondolas	
	250	70-ton gondolas	
	500	50-ton flat	
	500	50-ton box	

Passenger Car Orders

Road	No. of cars	Type of car	Builder
Bangor & Aroostook	5[2]	de luxe coaches	Pullman-Std. Car Mfg. Co.
	2	Comb. mail and bagg.	

Passenger Car Inquiries

Road	No. of cars	Type of car	Builder
St. L.-S. W.	10	Chair	

[1] 1,200 of these cars will be 52 ft. 6 in. long inside and 300 will be 65 ft. 6 in. long.
[2] Three of the coaches will be arranged with a small kitchen for buffet service.

P. R. R. to Electrify to Harrisburg, Pa.

The board of directors of the Pennsylvania, on January 27, authorized completion of the electrification of its lines for both passenger and freight service east of Harrisburg, Pa.

The chief parts of lines in the new electrification are the main line from Paoli, Pa., just west of Philadelphia, through Lancaster to Harrisburg; the low-grade freight line from Morrisville, Pa., near Trenton, N. J., via Columbia to Enola yard, near Harrisburg; the freight line from Columbia, Pa., following the course of the Susquehanna river to Perryville, Md., and the freight line from Monmouth Junction, N. J., to South Amboy, with the necessary yards, connecting branches and equipment. It will require about 18 months to complete the new work. The financing will be provided through a proposed $52,670,700 bond issue. The large freight and passenger yards at Harrisburg, Enola and South Amboy will be electrified to permit the movement of electrically-operated trains in and out of the yards and stations at these places. Additional yard electrification will also be installed at Philadelphia and Perryville. The company's announcement states that the new work will involve the electrification of 315 miles of line and 773 miles of track, and upon its completion, the Pennsylvania will have 2,677 miles of electrified trackage, or 41 per cent of the total electrically-operated standard railroad track in the United States.

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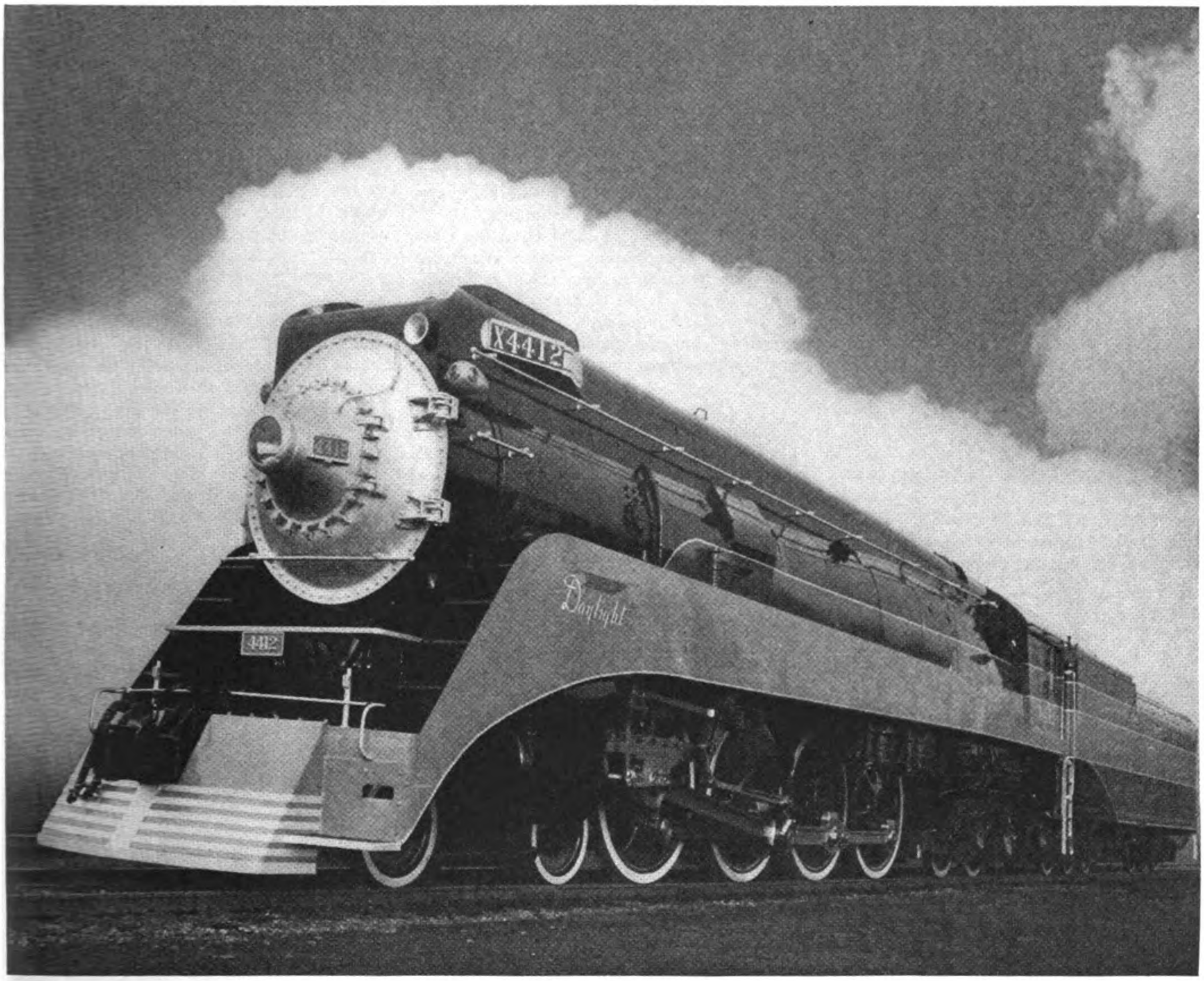

Modern Streamlined Power, built by Lima for the new Southern Pacific "Daylight" trains, which will operate between San Francisco and Los Angeles.

LIMA LOCOMOTIVE WORKS, LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

Supply Trade Notes

JAMES A. COOK, general sales agent of the Standard Forgings Corporation, Chicago, has been appointed vice-president, sales department.

THE CHICAGO RAILWAY EQUIPMENT COMPANY, Chicago, has moved its office at New York City from 90 West Broadway to 230 Park avenue.

C. W. MERRIKEN has been appointed director of sales of the asphalt division of the Continental Paint & Varnish Company, Chicago.

E. A. TURNER, vice-president of the Standard Stoker Company, Inc., has been appointed vice-president and general manager in charge of operations, with headquarters at New York.

DAVID S. YOUNGHOLM, vice-president of the Westinghouse Lamp Company has been elected vice-president of the Westinghouse Electric & Manufacturing Company. Mr. Youngholm's headquarters are at New York.

R. L. SALTER, superintendent of the Sayre, Pa., plant of the Southern Wheel Company, has been appointed chief inspector of the Association of Manufacturers of Chilled Car Wheels, with headquarters at Chicago.

THE WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J., has absorbed its subsidiary, the Carbondale Machine Corporation. Carbondale organization products, and sales activities, will be continued as a division of Worthington.

FREDERICK W. LUCHT has been appointed to the engineering staff of the Carboloy Company, Detroit, Mich. Mr. Lucht was formerly with the McCrosky Tool Corporation at Meadville, Pa., and prior to that was with the Goddard & Goddard Tool Company, Detroit.

CLIFFORD L. SHEEN, sales representative of the American Locomotive Company at St. Louis, Mo., has been appointed technical assistant to the vice-president, with headquarters in New York. William F. Lewis succeeds Mr. Sheen as sales representative at St. Louis.

THE NORTHWEST MAGNESITE COMPANY has appointed The Celotex Corporation, Chicago, exclusive sales agent for Thermax structural insulation and Absorbex acoustical corrective. R. E. Bennett, of the Thermax Division of The Northwest Magnesite Company, is now connected with The Celotex Corporation.

H. I. DUNPHY and J. H. Van Moss have been appointed assistant vice-presidents in the sales division of the American Car and Foundry Company, with headquarters at New York; W. L. Richeson, previously in charge of sales in the Cleveland, Ohio, district, has been appointed manager of sales with headquarters at New York, and R. A. Williams has been appointed district sales manager in charge of the Cleveland district.

L. E. CARLSON has been appointed district engineer for the southeastern district of the Westinghouse Air Brake Company with headquarters at Washington, D. C. Mr. Carlson was graduated from the University of Washington, Seattle, Wash., in the class of 1926, in mechanical engineering, after which he became an apprentice at the Wilmerding plant, and subsequently served in various capacities in the engineering department as a test division engineer.

PIERCE T. WETTER, who for ten years has supervised the technical professional divisions of the American Society of Mechanical Engineers, has resigned to become executive vice-president of American Cutting Alloys, Inc., 500 Fifth avenue, New York. Mr. Wetter will have charge of the company's development in the manufacture and sale of cemented carbide titanium tips and cutting tools, particularly for the cutting of steel at high speeds. He also becomes vice-president and assistant treasurer of the American Electro Metal Corporation of Lewiston, Maine, manufacturers of molybdenum and tungsten products.

W. L. LENTZ, engineer of motive power of the New York Central System, has resigned to become associated with the Standard Stoker Company, Inc., as assistant to F. P. Roesch, vice-president, in the capacity of sales manager, with headquarters at New York. Mr. Lentz was

W. L. Lentz

born on January 29, 1895, at Jersey Shore, Pa., where he was educated in the public schools. He completed an International Correspondence School course in mechanical engineering, and during the years 1917 and 1918 attended military schools at Cornell University and Fort Sill, becoming a commissioned lieutenant in the Aviation Corps and instructing cadets in that branch of the service. He entered the service of the New York Central in May, 1913, and, after completing an apprentice course in the locomotive shops, was subsequently assigned to road test work. In 1919 he was appointed apprentice instructor in the locomotive and car shops at West Albany, N. Y., and in May, 1920, was transferred to the equipment engineering department of the N. Y. C. at New York, successively occupying the positions of designer, traveling inspector, assistant engineer of motive power, and engineer of motive power.

THE INTERNATIONAL NICKEL COMPANY has concluded a license for the United States and Foreign countries to make, use and sell under Armstrong Patents Nos. 1,997,538 and 2,044,742 clad products, plates, sheets, etc., using the electrolytic iron bonding or welding process which has been used by the Latrobe Electric Steel Company for the past few years and more recently by the Jessop Steel Company.

THE CARNEGIE-ILLINOIS STEEL CORPORATION, Joliet, Ill., has transferred its plant and property to the American Steel & Wire Company, the property included being the splice bar mills, spike mills, merchant mills, and bolt and nut factory. Two blast furnaces and the coke plant will be retained by Carnegie. With the exception of the blast furnaces and the coke plant, the operations formerly conducted by Carnegie will be under the management of the American Steel & Wire Company. Carnegie-Illinois will market the track accessories manufactured at the Joliet works as previously.

EASTERN RAILWAY SUPPLIES, INC., 110 East Forty-second street, New York, has been incorporated by Ralph W. Payne, Washington, D. C., and Stanley H. Smith, Cleveland, Ohio, to carry on a general railway supply business. Waldo E. Bugbee, formerly associated with the National Lock Washer Company, has been appointed representative of the company. Messrs. Payne and Smith will continue to carry on their present business in Washington and Cleveland, respectively. The Nordberg Manufacturing Company, Milwaukee, Wis., has appointed the Eastern Railway Supplies, Inc., its representative.

JOHN H. RODGER, who has been elected president of The Oxweld Railroad Service Company, Chicago, one of the units of the Union Carbide & Carbon Corporation, entered the railway supply business in New York in 1899 with the Standard Coupler Company. In 1911 he joined The Safety Car Heating & Lighting Company at Chicago, remaining with this organization 17 years, serving successively as representative, western manager, and vice-president in charge of the Chicago district, and subsequently, vice-president at New York. In 1928 he resigned to become vice-president

(Continued on next left-hand page)

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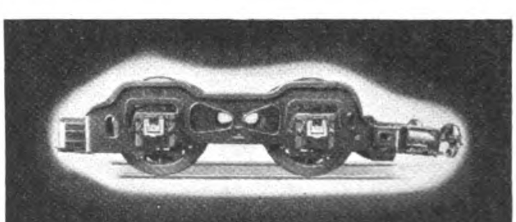

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

of The Oxweld Railroad Service Company, Chicago, and in 1930 was made executive vice-president, which position he held until his recent election as president.

Obituary

J. W. Savage, railway sales representative of the DeVilbiss Company, Chicago, died in that city on December 31 of pneumonia.

Raymond C. Dudley, who retired as president of the Chicago Cleveland Car Roofing Company, Chicago, in 1925, died in that city on January 3 of heart failure. He had been connected with the railway supply business since 1906.

Theodore H. Goodnow, vice-president of the Camel Sales Company, Chicago, subsidiary of the Youngstown Steel Door Company, died in Oak Park, Ill., on January 1 of pneumonia. Mr. Goodnow was

Theodore H. Goodnow

born at Lathrop, Mo., on July 22, 1872, and entered railway service in 1890 with the Lake Shore & Michigan Southern (now part of the New York Central) at the Norwalk, Ohio, shops. In 1906 he was promoted to master car builder, which position he held until January, 1912, when he resigned to become general superintendent of the car shops of the Armour Car Lines. In August, 1912, he was appointed assistant superintendent and, subsequently, superintendent of the car department of the Chicago & North Western, which position he held until February, 1924, when he was elected vice-president of the Ryan Car Company. In September of that year he was elected vice-president of the Camel Sales Company.

Howard J. Evans, in charge of railroad sales for The Lunkenheimer Company, Cincinnati, Ohio, died on January 5, at St. Petersburg, Florida, after an illness of several weeks. Mr. Evans had been associated with The Lunkenheimer Company since 1900.

Personal Mention

E. L. Johnson, assistant engineer of tests of the New York Central, has been appointed engineer of tests, with headquarters at New York, succeeding H. W. Faus.

E. L. Bachman, who has been appointed general superintendent of motive power of the New York zone of the Pennsylvania, with headquarters at New York, as noted in the January issue, was born in 1881

(C) *Harris & Ewing*
E. L. Bachman

at Coshocton, Ohio, and entered railroad service in 1902 in the Dennison, Ohio, shops of the Pennsylvania. After filling many positions in various shops and enginehouses he became master mechanic at Mingo Junction, Ohio, in 1926, and subsequently served in the same capacity at Wellsville, Ohio, and Olean, N. Y. Mr. Bachman was appointed master mechanic of the Philadelphia division in June, 1929, and just recently became general superintendent of motive power of the N. Y. zone.

Thomas W. Demarest, who has been assigned to duty on the staff of the chief of motive power of the Pennsylvania at Philadelphia, Pa., as noted in the January issue, was born on March 18, 1868, at Englewood, N. J., and is a graduate of Stevens Institute of Technology, Hoboken, N.

T. W. Demarest

J. He entered the service of the Pittsburgh, Cincinnati & St. Louis (now P.R.R.) on August 1, 1889, as a special apprentice at Columbus, Ohio. From August, 1891, to February, 1896, he was assistant to superintendent motive power at Columbus, and from the latter date until February, 1897, assistant to master mechanic at Indianapolis, Ind. He served as general foreman locomotive department at Indianapolis from February, 1897, to August, 1899; master mechanic at Logansport, Ind., from August, 1899, to January, 1900 superintendent motive power, from January, 1900, to July, 1903, all with the Pittsburgh, Cincinnati & St. Louis and its successor, the Pittsburgh, Cincinnati, Chicago & St. Louis (now Pennsylvania). He was superintendent motive power, Northwest system, Pennsylvania Lines West of Pittsburgh, at Ft. Wayne, Ind., from July, 1903, until March, 1920, and from the latter date until June, 1925, served as general superintendent motive power, Northwestern region, Pennsylvania System, at Chicago. Mr. Demarest became general superintendent motive power of the Western region at Chicago in June, 1925, which position he was holding at the time of his transfer to Philadelphia.

H. H. Haupt, who has been appointed general superintendent of motive power of the Central Region of the Pennsylvania, at Pittsburgh, Pa., as noted in the January issue, was born in Germany in 1892 and was educated at the Royal Wilhelms Gymna-

H. H. Haupt

sium at Cassel, Johns Hopkins University and the University of Pennsylvania. He entered railway service in 1911 as apprentice in the Altoona machine shops of the Pennsylvania, during the summer months, while continuing his college studies. In 1916 he was appointed motive power inspector and in November, 1917, became assistant master mechanic at Harrisburg. On October 1, 1918, Mr. Haupt was promoted to the position of assistant engineer of motive power, with headquarters at Williamsport,

(Continued on next left-hand page)

Pa., where he remained until 1924, when he was appointed master mechanic at Wilmington, Del. In May, 1928, the Northwestern division was created and Mr. Haupt was appointed superintendent of motive power of that division at Chicago. In October, 1929, he was appointed superintendent of motive power of the Northern division at Buffalo, N. Y., and in May, 1932, became master mechanic of the Central division, at Buffalo. He was appointed superintendent of motive power of the Eastern and Central Pennsylvania divisions in November, 1933.

G. T. WILSON, former general equipment inspector (locomotives) of the New York Central, has been appointed automotive engineer, succeeding W. F. Collins.

W. C. WARDWELL has been appointed assistant to assistant chief engineer motive power and rolling stock of the New York Central, succeeding to the duties of G. T. Wilson, former general equipment inspector (locomotives).

A. C. MELANSON, superintendent of the St. Malo shops of the Canadian National, has been appointed superintendent of motive power and car equipment, Quebec district, succeeding H. W. Sharpe, who has retired. Mr. Melanson will continue to have jurisdiction over the St. Malo shops in addition to his new duties.

A. K. GALLOWAY, who has been appointed superintendent of motive power and rolling equipment of the Reading and the Central of New Jersey at Reading, Pa., as noted in the January issue, was born

A. K. Galloway

on October 1, 1885, at St. Thomas, Ont. He entered the service of the Baltimore & Ohio on November 1, 1914, as master mechanic on the Baltimore division and in July, 1916, he was appointed district master mechanic of the Northwest district, being transferred in the same capacity to the Maryland district in February, 1917. Mr. Galloway served in the latter position until April, 1927, when he was appointed superintendent motive power of the Western lines of the Baltimore & Ohio, with headquarters at Cincinnati, Ohio, and subsequently he was transferred as superintendent motive power to the Eastern lines, with headquarters at Baltimore. He was holding the latter position at the time of his appointment as superintendent of motive power and rolling stock at Reading.

W. F. COLLINS, automotive engineer of the New York Central, has been appointed assistant engineer of tests, succeeding E. L. Johnson.

CHARLES A. GILL, who has been appointed general manager of the Reading and the Central of New Jersey at Reading, Pa., as noted in the January issue, entered the service of the Baltimore & Ohio in 1896 as a call boy in the motive power department, later becoming a machinist in

Charles A. Gill

the Mount Clare (Baltimore) shops of the same company. In the years following he acquired a varied experience as mechanic, general foreman, master mechanic and general master mechanic. On February 1, 1917, he was appointed superintendent of motive power of the Eastern lines of the Baltimore & Ohio, remaining in that position until February 10, 1931, when he accepted from the Soviet government a one-year appointment as chief consulting engineer of the railway systems of the Union of Soviet Socialist Republics. In that capacity he aided in the development of motive power and other equipment problems of the Soviet system, and also advised in the expenditure of the 1931 Russian railroad budget, amounting to $1,700,000,000 and covering some 60,000 miles of line. Mr. Gill's first position upon his return from Russia early in 1932 was assistant to chief motive power and equipment of the Baltimore & Ohio. He became special representative of the Reading later in 1932 and in September of the same year was appointed superintendent motive power and rolling equipment of the Reading Company. His jurisdiction was extended to include the Central of New Jersey on September 1, 1933. He now becomes general manager of the companies.

H. W. SHARPE, superintendent of motive power and car equipment of the Quebec district of the Canadian National, has retired. Mr. Sharpe was born on December 6, 1869, at Campbellton, N. B. He entered railroad service in September, 1883, as a messenger of the Intercolonial Railway (now Canadian National) at Campbellton. He became a helper in the mechanical shops of the Intercolonial at Campbellton in August, 1884; locomotive fireman in that city in November, 1886, and locomotive engineer at Levis, Que., in February, 1890. Mr. Sharpe served as division master mechanic of the Intercolonial successively at Riviere du Loup, Que., and Levis from November, 1912, to December, 1918, when he became district master mechanic of the Canadian National at Quebec, Que. On March 1, 1923, he was appointed superintendent of motive power and car equipment at Quebec.

H. W. FAUS, engineer of tests of the New York Central System, with headquarters at New York, has been appointed engineer of motive power, succeeding W. L. Lentz, who has resigned. Mr. Faus was born on July 28, 1886, at Munsey Valley, Pa. He was graduated from Syracuse University in 1910 with a degree in civil engineering. He began his business career in 1901 in the office of the Lehigh Valley Coal Company at Snow Shoe, Pa., serving with this firm until 1904. During the summer of 1905 he worked as colliery clerk with the Pennsylvania Coal & Coke Company at Hastings, Pa. Mr. Faus entered railroad service in 1910 and served until 1912 as rodman, leveler, transitman, bridge inspector and bridge engineer with the Canadian Northern (now C. N. R.) in Ontario and British Columbia. From 1912 to 1915 he was resident engineer of the Kettle Valley (C. P. R. system) at Hope, B. C., and Penticton, B. C., and from 1915 to 1917 was special engineer of the New York Central Lines at New York. He served successively as office

H. W. Faus

engineer, plant engineer, resident engineer and chief administrative officer for the U. S. Shipping Board Emergency Fleet Corporation, Bristol, Pa., from 1917 to 1923. From 1923 to 1926 he was special engineer and engineer materials and equipment tests with the New York Central. In 1926 he became engineer of tests.

Master Mechanics and Road Foremen

J. C. HARRIS, master mechanic of the Southern Pacific at El Paso, Tex., has retired.

(*Continued on next left-hand page*)

J. L. CATO has been appointed master mechanic of the Southern Pacific Lines in Texas and Louisiana, with headquarters at El Paso, Tex., succeeding J. C. Harris.

H. C. WYATT, formerly a foreman at the Iaeger, W. Va., shop of the Norfolk & Western, has been promoted to the position of assistant road foreman of engines, Pocahontas division.

C. P. BLAIR, a draftsman in the office of the mechanical engineer of the Norfolk & Western at Roanoke, Va., has been transferred to the Radford division as assistant road foreman of engines.

J. S. BELL, assistant enginehouse foreman on the Philadelphia Terminal division of the Pennsylvania, has been appointed assistant master mechanic of the Columbus, Cincinnati and Toledo divisions, with headquarters at Columbus, Ohio.

ELMER A. KUHN, master mechanic of the Canadian division of the Pere Marquette at St. Thomas, Ont., has been transferred to Saginaw, Mich., as master mechanic of the Saginaw district.

M. L. CRAWFORD, master mechanic of the St. Louis-San Francisco at Sherman, Tex., has been transferred to Springfield, Mo., to succeed J. L. Harvey, who has resigned.

H. REES, master mechanic of the Western lines of the Baltimore & Ohio at Akron, Ohio, has been appointed district master mechanic with headquarters at Cincinnati, Ohio, succeeding E. J. McSweeney.

WALTER F. HARRIS, general foreman of the Akron and Chicago divisions of the Baltimore & Ohio at Willard, Ohio, has been appointed division master mechanic, with headquarters at Akron, Ohio. Mr. Harris was born at Cannelsburg, Ind., on January 20, 1884, and attended public school at Washington, Ind. He became a machinist apprentice in the employ of the Baltimore & Ohio at Washington, Ind., on November 6, 1900; machinist at Washington on November 6, 1904; general foreman at Seymour, Ind., on October 6, 1909; general foreman at Washington on September 20, 1914; master mechanic at Flora, Ill., on July 16, 1916; district motive power inspector on March 1, 1919, and master mechanic at Willard, Ohio, on February 21, 1927. On February 1, 1933, with the consolidation of the Akron and Chicago divisions, Mr. Harris became general foreman at Willard.

Shop and Enginehouse

J. P. BECKER, general locomotive inspector of the Chicago, Great Western at Oelwein, Iowa, has been appointed general locomotive and boiler inspector.

H. B. ROBINSON, gang leader of the Norfolk & Western at Crewe, Va., has been promoted to the position of foreman at the Iaeger, W. Va., shop.

Purchasing and Stores

A. C. JOHNSON, district storekeeper of the Como store of the Northern Pacific at St. Paul, Minn., has been transferred to South Tacoma, Wash., replacing H. A. Humes, deceased.

K. H. SUDER has been appointed purchasing agent of the Akron, Canton & Youngstown and the Northern Ohio, with headquarters at Akron, Ohio.

Obituary

WILLARD KELLS, formerly general superintendent motive power of the Atlantic Coast Line, died suddenly of heart disease at his home in Wilmington, N. C., on January 18. Mr. Kells was born in Dennison, Ohio, on February 4, 1868. He was educated in the public schools of Cleveland, Ohio, and on March 1, 1888, entered railroad service as a machinist apprentice on the Erie at Susquehanna, Pa. After serving his full apprenticeship he rose through various positions to become master mechanic at Cleveland, Ohio; Lima, Ohio; Huntington, Ind., and Meadville, Pa. For a short time he was assistant master car builder of the Union Tank Line at New York, and from April, 1899, to December, 1910, was master mechanic of the Lehigh Valley successively at Auburn, N. C.; Sayre, Pa., and Buffalo, N. Y. In December, 1910, he became assistant to general superintendent motive power of the Atlantic Coast Line at Wilmington, N. C. From 1911 to 1918 he was assistant general superintendent motive power, and from 1918 to 1920 general superintendent motive power. Because of failing health, he relinquished many of his duties and was superintendent motive power until his resignation in October, 1923.

Willard Kells

F. D. CAMPBELL, assistant superintendent, car department, Chicago, Milwaukee, St. Paul & Pacific, Tacoma, Wash., died at Tacoma on December 14, 1936. Mr. Campbell was born in Prairie du Chien, Wis., April 10, 1863, and entered Milwaukee Road service in 1879 at Farmington, Minn. In 1882 he went with the car department as a bridge and building carpenter and cabinet maker. In 1892 he was coach yard foreman at Minneapolis, and in 1893 became car foreman at Aberdeen, S. D., where he remained until 1907, when he went to Lines West as general foreman. In 1917, he was appointed assistant superintendent.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

BEAVER PIPE TOOLS.—Catalog No. 37, issued by Beaver Pipe Tools, 330-770 Dana Ave., Warren, Ohio, includes 40 new and 18 improved Beaver items brought out since 1929.

ELESCO EQUIPMENT.—The new Elesco equipped passenger locomotives for the Canadian National Railways are featured in the four page bulletin issued by The Superheater Company, 60 East Forty-second street, New York.

THREADING EQUIPMENT.—The entire line of Oster-Williams pipe and bolt threading equipment and welding equipment is illustrated and described in the catalog of the Oster Manufacturing Co., 2087 East Sixty-First Place, Cleveland, Ohio.

AIRCO ACETYLENE.—In a 12-page booklet the Air Reduction Sales Company, 60 East Forty-Second street, New York, presents the story of acetylene vs. various other fuel gases—its history, heating, efficiency and B.t.u. heat values, etc.

DIESEL ENGINES.—The Cooper-Bessemer Corporation, Mt. Vernon, Ohio, has released a bulletin describing their Type GN Diesel, built in three, four, six and eight cylinders and rated at 50 to 58 hp. per cylinder. Powering Diesel railway locomotives is listed among the major applications of the Type GN Diesels.

"FINISHES FOR ALUMINUM."—The Aluminum Company of America, Pittsburgh, Pa., has prepared this spiral-bound booklet to assist the users of aluminum in solving their finishing problems. The discussions cover the characteristics of aluminum, mechanical finishes, chemical dip finishes, electrolytic oxide finishes, electroplating on aluminum, "Alclad" products, and paint, lacquer and enamel finishes.

SYLPHON CONTROL.—The Fulton Sylphon Company, Drexel building, Philadelphia, Pa., has issued two 4-page bulletins descriptive of the Sylphon control of passenger-car heating and the Sylphon control on ice-activated cars. The arrangements of the modulating temperature control and the automatic differential control, respectively, on these installations are shown diagrammatically.

VALVES AND FITTINGS.—Standard Marking.—A new edition of the "MSS Standard Practice," SP-25, covering MSS standard marking system for valves, fittings, flanges and unions has been issued by the Manufacturers Standardization Society of the Valve and Fittings Industry, 420 Lexington avenue, New York. A number of tables definitely outlining the standard method of applying uniform markings to a wide variety of products more specifically visualize the general rules. The price of this edition is 50 cents.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

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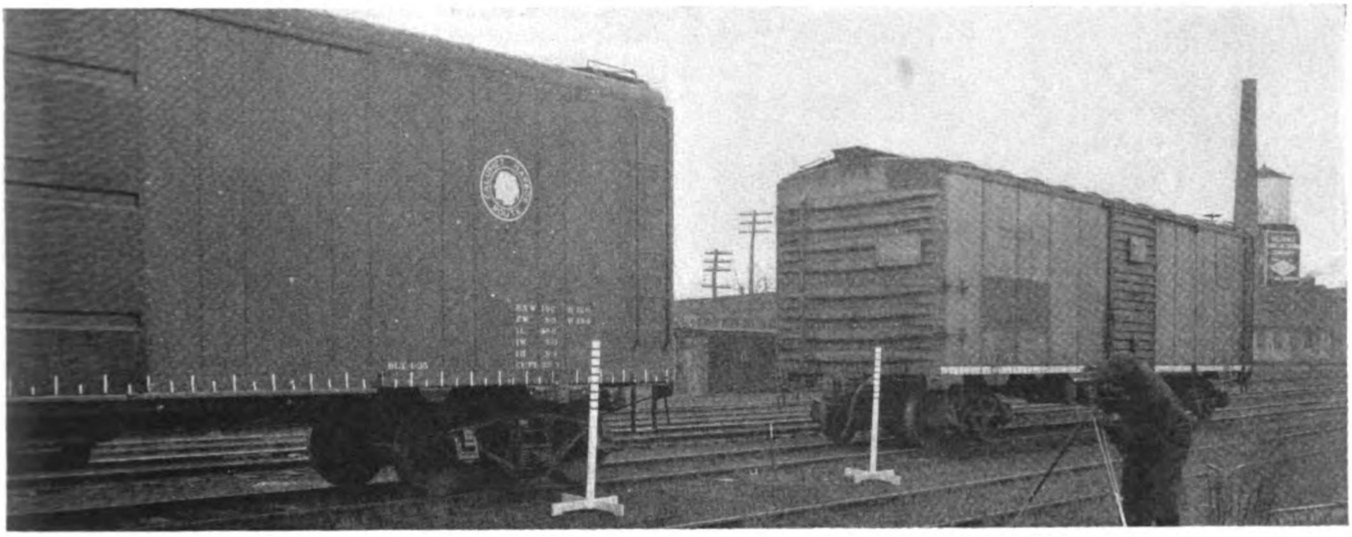
RAILWAY
MECHANICAL ENGINEER



Impact test, with A.A.R. standard box car about to strike Pullman-Standard all-welded alloy-steel car P.L.M. 500—Car speed recorded by movie camera

Dynamic Stresses in

Freight-Car Design

By W. H. Mussey*

Abstract of a Western Railway Club paper showing that much of the guesswork can be taken out of car design

IT HAS been the feeling of the Pullman-Standard Car Manufacturing Company for a considerable period that the ratio of car light weight to revenue lading capacity is an important economic transportation factor. Just what the savings are or will be a year per car, due to saving a pound in tare weight, we cannot predict in dollars and cents, except in specific cases. That there is a saving is admitted by all, but we return to the basic query, what does it cost to haul a ton a mile?, and the answer can be given only in specific cases. It is apparent that very small savings in car light weight would not be especially attractive, but if these savings were of some magnitude and could be obtained without sacrifice of car life and strength, and without any considerable increase in cost, the savings would be attractive in reducing operating costs by reducing train-miles for a given volume of traffic.

Formerly, the sizes of stress members in car structures were calculated by formulae, which assured cars of ample strength to meet service requirements, but we didn't know the detailed stresses throughout the structure and the exact ratio of static to live-load stresses at any one point. The above live-load stresses are the ones produced by car body and lading, due to track variation and defects. We had considerable experience in procuring static load stresses by means of extensometers which are calibrated to indicate stresses at any point in pounds per sq. in. But these instruments are of the indicating type and will not truly indicate live load or vertical impact, they merely show static stresses.

By taking stress readings at increments of the static load up to full load, we established a static stress trend line. Using a deflectometer (designed and built by us) under the same conditions at the same positions, we obtain deflections corresponding to the extensometer readings, and these deflections are plotted to establish a static deflection trend. The deflectometers are mounted on a framework supported only at the body bolster position at the sidesill, thus insuring deflections being referred to fixed positions. Two wedge-type blocks are placed one on each rail, one being approximately 18 in. forward of the other. The two wedges are of the same height and are used in increments up to 2½ in. in height at the peak or drop-off point. The car is pulled slowly over these wedges, and, at the top, there is an abrupt drop to the rail. The action approximates passing over

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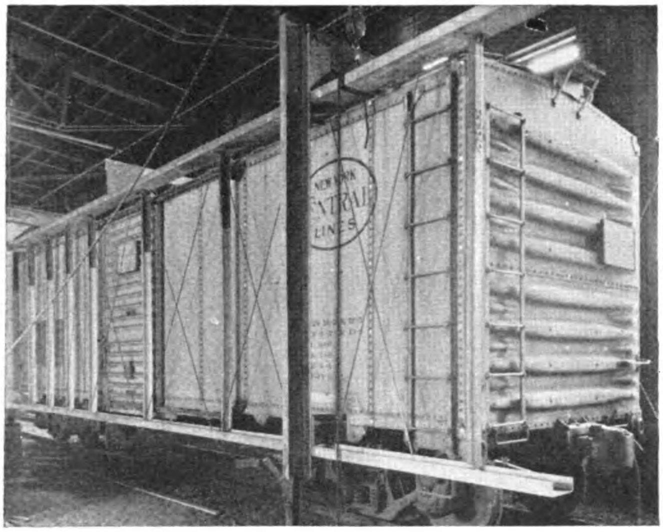
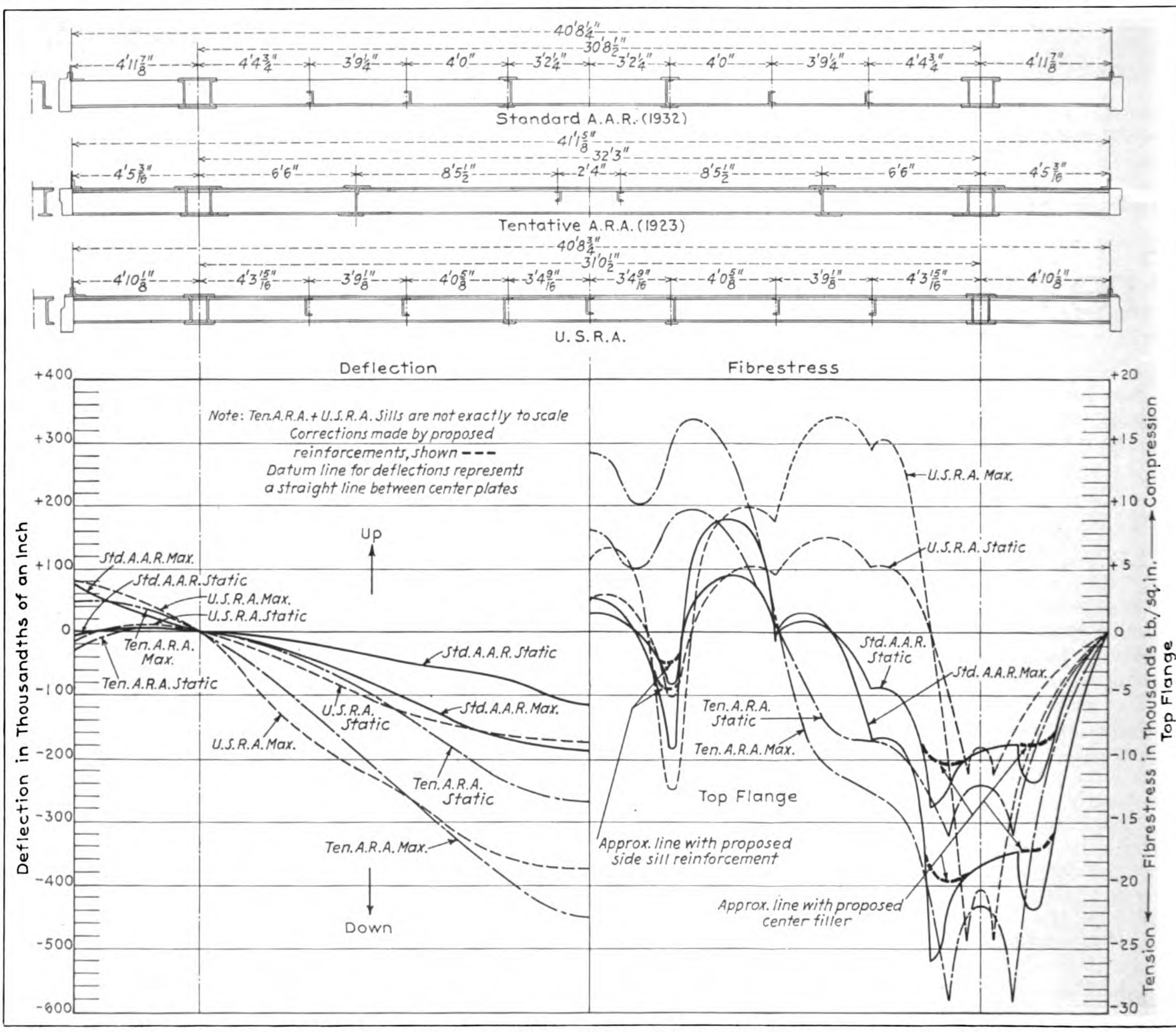


Special frame used in checking the car structure, after impact tests, to detect permanent set in any of its members

rail joints at high speed. The deflections obtained under this test are plotted as an extension of the deflection graph. If there has been no distortion of the structure and the stresses are within the yield points of the materials, the stresses are proportional to deflections and the stress graph is extended on that basis to cover live-load stresses. It might be said that the frame supporting the deflectometers is subject to some deflection, due to its inertia when dropping off the wedge blocks. These frame deflections are all recorded and correction curves established which are used as deducts to insure proper deflection readings. We established a 2½-in. wedge height as the maximum necessary for testing purposes by a rather unique method, observing the maximum distortion of framing members in various types of cars. We loaded the cars to journal capacity and increased the height of track wedges to a point that dropping of the car structure from that height at least duplicated the distortion observed.

One of the illustrations shows the deflectometer and extensometer applications on a car ready for testing. The readings recorded by the deflectometer pencil are approximately eight times the actual deflection. Each small division on the extensometer is approximately 1,000 lb. per sq in. for a material having a modulus of elasticity of 29,400,000, which corresponds to low-carbon normal steel. These instruments are always calibrated previous to making tests. Data are developed and curves



Typical comparative deflection and stress curves showing superiority of the A. A. R. standard center sill—Peak stresses still further reduced in car P. L. M. 500 design

drawn for the maximum static and live-load stresses and deflections.

A study of deflections and stresses in the P. L. M. welded Cor-Ten steel box car, designed and built in 1935 by the Pullman-Standard Car Manufacturing Company, indicates, first, the low magnitude of the stresses; second, lack of concentrated or peak stress and uniform smoothness of deflection and stress curves; third, the relatively small increase of live over static load deflections and stresses.

In comparing the A. A. R. standard box car and the light-weight welded box car, P. L. M. No. 500, the stress curves of the latter car are reduced in proportion to the yield strength of the two kinds of steel used E. I. 3 to 5. It is apparent from the foregoing that the investigation of stresses and deflections of load carrying is of such completeness as to thoroughly develop full data and a comprehensive check for all vertical loading, both static and live load.

Further investigations cover the behavior of the car structure under car or train impact conditions, the car tested being the struck car, as it is subjected to a considerably greater blow than the striking car.

How Impact Tests Were Made

In the test illustrated, the P. L. M. welded box car No. 500 was the struck car and N. Y. C. car No. 100,000 standard A. A. R. riveted car was the striking car.

Various spots, about 400 in number for each car, were located as measurement points for ascertaining the static deflection or distortion from light car to full capacity load, and again measurements after each series of impacts, and finally observation of structure stabilization or permanent set with load removed at desired intervals after final runs. The spots cover all positions required to give full data for drawing curves for all essential parts of the car body.

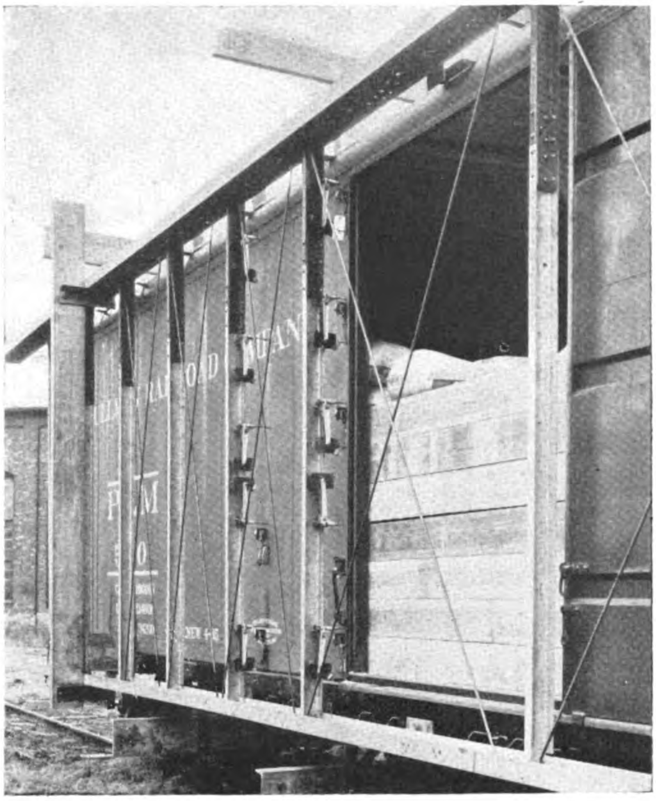
One of the illustrations shows bags loaded in a car, each bag weighing 100 lb. and being filled with a mixture of sand and sawdust, so that with cars loaded to load-carrying capacity, the height of the load in the car is sufficient to give a severe operating condition. The same method of loading was followed out in connection with extensometer and deflectometer tests for vertical load action.

Two sets of tests were made: first, a fully loaded moving car striking a single fully loaded test car at rest at speed increments increasing at the rate of about one mile an hour up to about a 16 m.p.h. speed; second, a fully loaded moving car striking a half loaded test car at rest at the head of a string of five or six empty cars.

The two types of impact tests cover all service conditions. The first described has always proved the more severe. Speeds have been used in some of these tests as high as 18 m.p.h. in connection with impacts between striking car and struck car. The testing procedure follows: Relatively straight, level trackage is selected, of sufficient length to permit the struck car rolling to a stop.

The struck car is placed at a marked spot on the rail, so that the travel to stop can be accurately measured for both striking and struck car.

Coupler knuckles are held open so that movements of the striking and the struck car are independent. Speed at the time of impact is accurately checked for each test run. Coupler or draft-gear movement for each car is taken from the chart. The movement shown on the impact-registering instrument on each car is recorded. Truck springs are checked to ascertain the force acting on these springs for all trucks. The distance each car moved from the point of impact is measured. All defects are recorded in detail. On the average, three or four test runs constitute a group, and each group approximates a speed increase of three to four miles per hour.



Car P.L.M. 500 equipped with extensometers and deflectometers, the latter being supported on a light but rigid metal frame

After each group of runs, the cars are minutely examined for defects and any conditions brought about by the group of tests. They are then placed in the measuring frame and the complete set of measurements taken. These are recorded and afterward drawn up in chart form for each group of tests. A contour sketch is made showing shifting and lading.

If deemed advisable, the load is removed and measurements made, as a check against the original condition. Otherwise, the load is leveled off to the original condition and the next group of test runs is carried out.

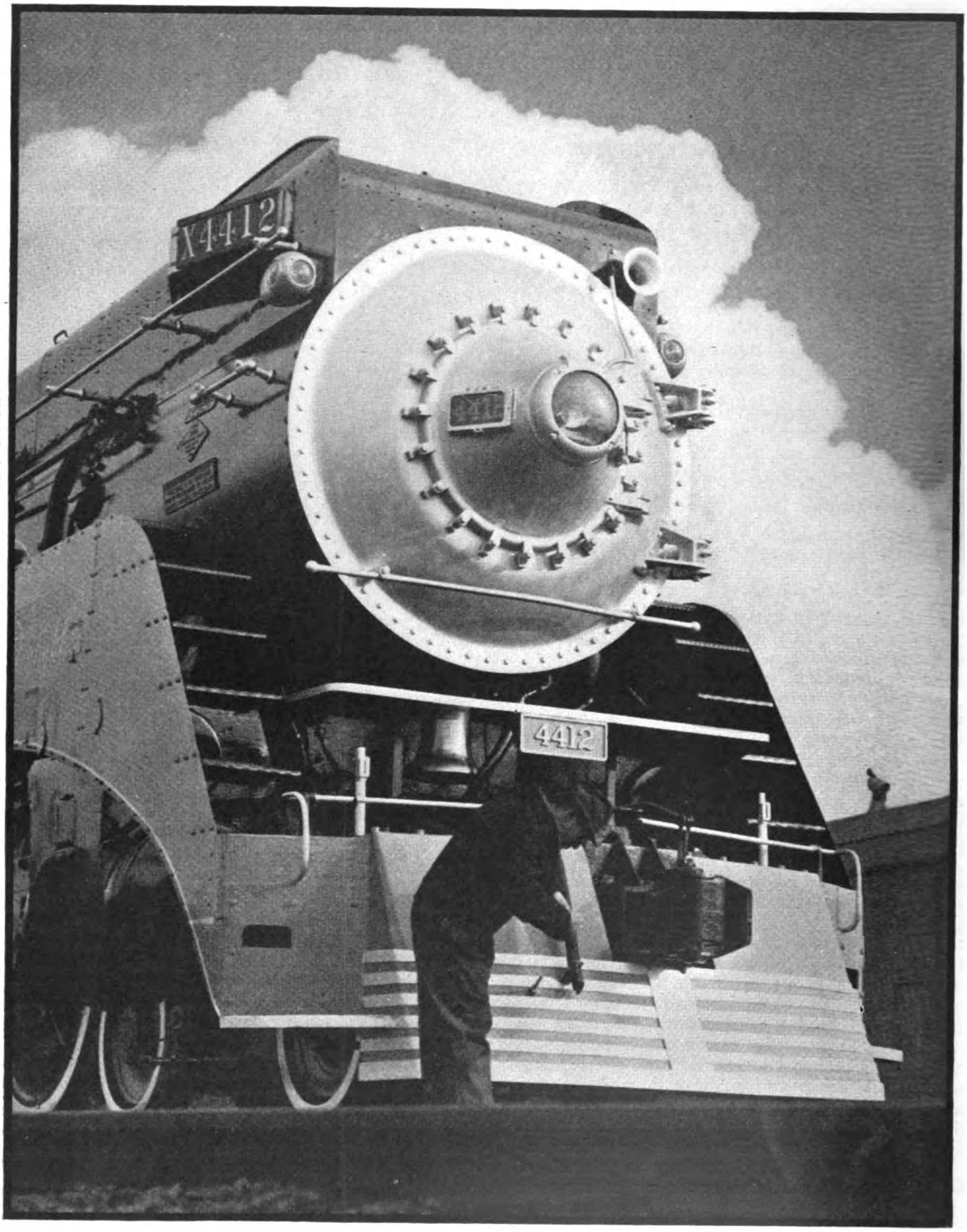
The impact test might almost be called a destructive test. The speeds obtained are far above those which occur in service. The shifting of lading and its wedging action is cumulative, beyond a point of which we have any knowledge as occurring in operation. Maybe the test is too severe when compared to everyday service. Anyone can surmise the effect on car lading subjected to these test conditions. However, the data obtained is invaluable as a check on the structure and as information for the car designer and builder.

"Where Do We Go From Here"

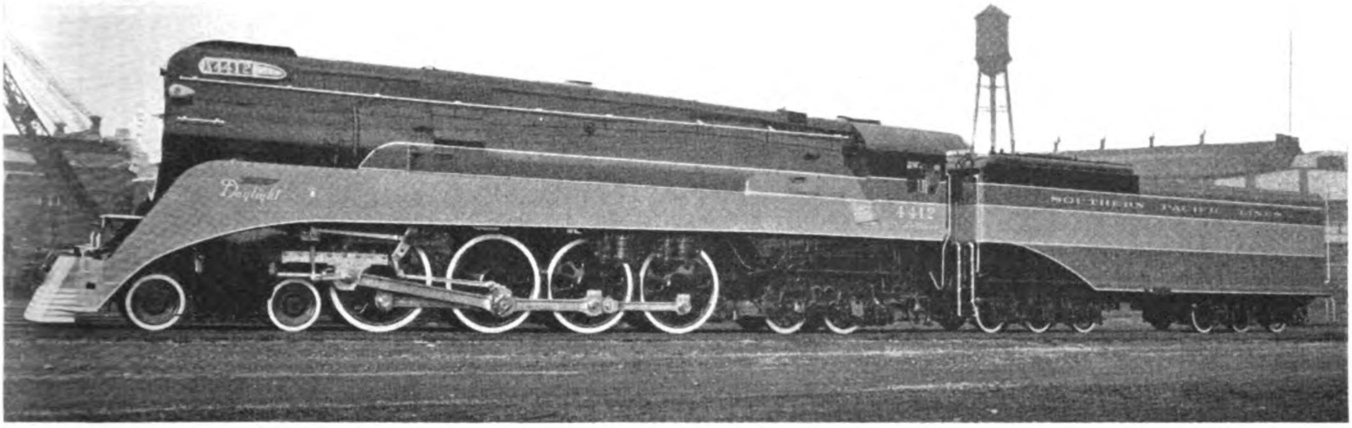
Naturally, the question is, where do you go from here? Car structure essentials are thus brought to the attention of the car designer and builder. He knows which stress members of the structure may be reduced in section or, in rare cases, which may be increased. He knows the allowance that must be made for live or dynamic load over static load for each member, as the ratio is not constant for all parts of the car.

With the usual materials of car construction he knows the value of a pound at any particular point in the structure and how light a structure can be safely built. With

(Continued on page 122)



The streamlining and decoration of the front end of the Southern Pacific locomotives is simple and effective. The smokebox front is aluminum and the pilot orange with aluminum bands



Southern Pacific 4-8-4 type passenger locomotive streamlined and finished to conform to the train

Streamline

Steam Passenger Locomotives

Southern Pacific light-weight trains, working over a severe profile on accelerated schedules, call for high traction and fast running. The Lima-built locomotives are designed for this specific service

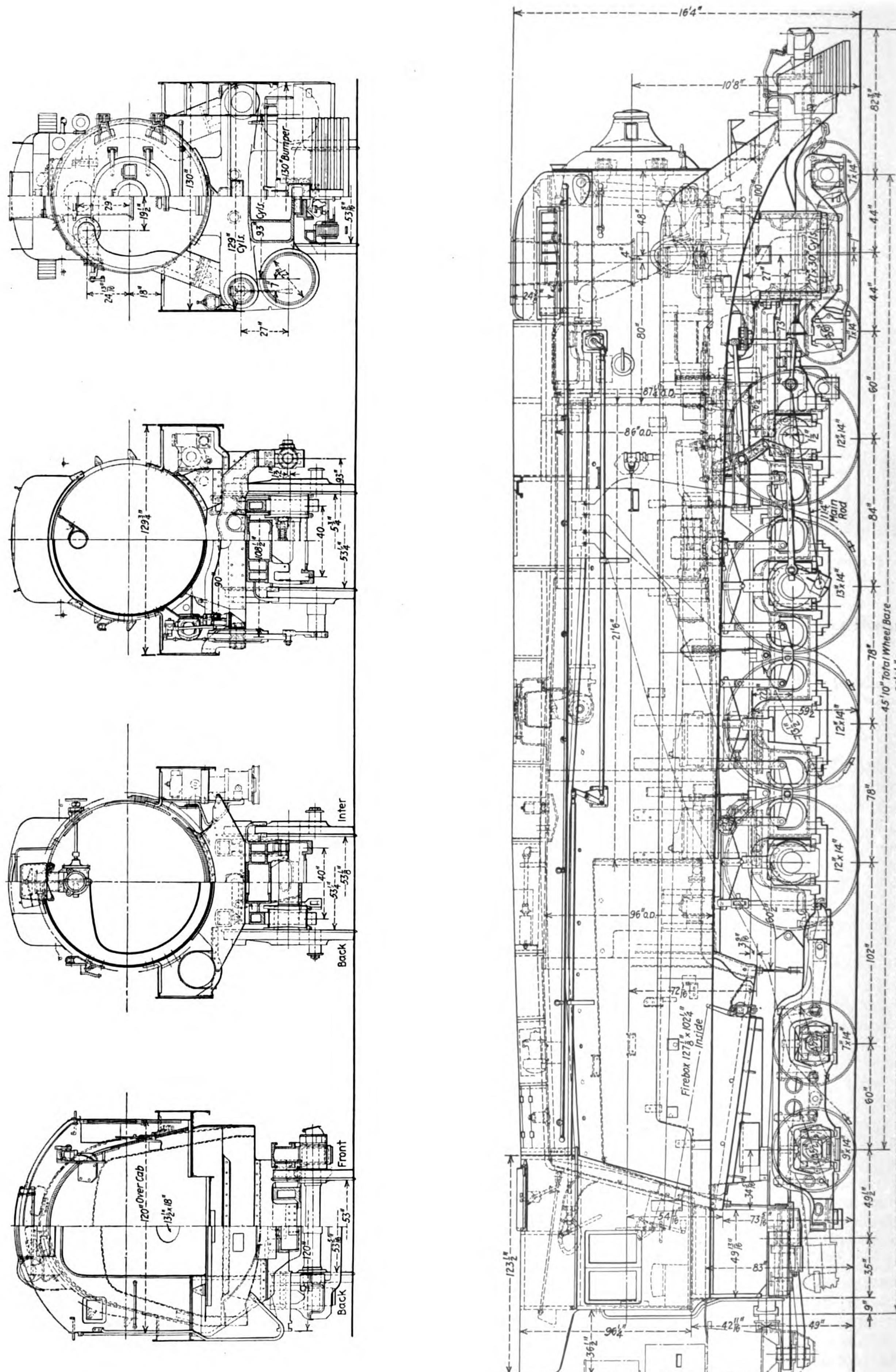
THE Lima Locomotive Works, Inc., has delivered six streamline passenger locomotives of the 4-8-4 type to the Southern Pacific for use on the new Daylight train service between Los Angeles and San Francisco to be inaugurated during the coming spring. The locomotives develop 74,710 lb. tractive force, including the trailer booster. The weight on drivers is 266,500 lb., the cylinders are 27 in. by 30 in., the driving wheels 73½ in. in diameter, and the boiler pressure 250 lb. per sq. in.

These locomotives have been streamlined by enclosing the sandbox, dome and other equipment mounted on the top of the boiler within a smooth casing, and by applying deep aprons below the outside edges of the running boards, which join the metal-covered pilot in long sweeping curves. The headlight is enclosed within a casing which is faired into the smokebox door and through the sides of which are openings for the illuminated engine numbers.

A striking color effect has also been achieved by the extensive use of red and orange on the sides of the locomotive and tender. The smokebox front is painted aluminum and the train-number indicators are aluminum with black stripes. The streamline hood of the pilot is in orange with aluminum bands. The name of the train is lettered in aluminum on the orange of the apron below the running board on each side. The emblem associated with the lettering is in red, outlined in black. The marker lamps are in aluminum. The cylinders are finished in black, and the guides, the main and side rods and the motion work are steel with a highly polished finish. The tires and wheel rims on all wheels are painted in aluminum, with steps and grab handles cadmium plated. The red on the sides of the boiler above the running board and on the sides of the tender, separated by the band of orange, will match the same color on the sides of the coaches and the yellow panel will line up with the window panel of the coaches.

The Boiler

The boiler has an outside diameter of 86 in. at the first ring. It is designed to carry 250 lb. pressure and is built of carbon steel of basic flange quality. The firebox is equipped for oil burning and the combustion space includes a chamber extending 60 in. into the boiler barrel. Welding is employed at the ends of the longitudinal seams in the barrel courses, and the firebox sheets are seal welded to the mud ring 12 in. each way from the corners. Calking edges of the back firebox are lightly welded to the crown sheet after calking. The staybolts are of Ulster iron with an installation of Flannery telltale type flexible bolts at the usual corner breaking zones



Cross-sections and elevation of the Southern Pacific locomotive

and also completely around the combustion chamber.

The firebox is equipped with an installation of fusible plugs of the type developed on the Southern Pacific. There are three plugs along the top center line, one between the first and second rows of the crown stays, one between the seventh and eighth, and one between the fifteenth and sixteenth rows. Two laterally spaced plugs are located between the eleventh and twelfth rows.

The boiler is equipped with a type E. superheater with a Tangential steam dryer in the dome. An American multiple front-end throttle is built in the superheater header. The feedwater heater is the Worthington type 5SA. The boiler is also equipped with the Signal Foam-Meter.

The foundation for these locomotives is a steel bed casting with which the cylinders are cast integral. The firebox is suported, both front and back, by expansion sheets. These, are attached to bolting flanges which extend practically across the entire length of the front and back mud-ring members and are supported from ample bolting flanges on the bed casting both inside and outside of the side-frame parts of the casting.

The engine and trailer trucks are also General Steel Castings design, the former with inside bearings and the latter of the four-wheel Delta type. The trucks are all fitted with oil-packed journal boxes. The driving wheels are cast steel of the Boxpok type. All driving axles, as well as the engine-truck and trailer axles, are of medium carbon steel normalized and drawn.

The cylinders are fitted with two-stage bushings which, like the valve bushings, are of Hunt-Spiller gun iron. The valve bull rings are also of this material and are fitted with Hunt-Spiller duplex sectional packing rings. The pistons are of cast steel, without separate bull rings, and are fitted with the Locomotive Finished Material Company's bronze packing rings. Paxton-Mitchell packing is applied to the valve stems and piston rods.

All rods and motion work are finished with a high polish, free from surface marks, in accordance with the

General Dimensions, Weights and Proportions of the Southern Pacific 4-8-4 Type Locomotives

Railroad	Southern Pacific
Builder	Lima Locomotive Works
Type of locomotive	4-8-4
Road class	G-52
Road numbers	7646—7651
Date built	1936
Service	Passenger
Dimensions:	
Height to top of stack, ft. and in.	16— 4
Height to center of boiler, ft. and in.	10— 8
Width overall, in.	10—11
Cylinder centers, in.	93
Weights in working order, lb.:	
On drivers	266,500
On front truck	77,400
On trailing truck	104,500
Total engine	448,400
Tender	372,880
Wheel bases, ft. and in.:	
Driving	20— 0
Rigid	13— 0
Engine, total	45—10
Engine and tender, total	94—½
Wheels, diameter outside tires, in.:	
Driving	73½
Front truck	36
Trailing truck	45½
Engine:	
Cylinders, number, diameter and stroke, in.	2—27×30
Valve gear, type	Walschaert
Valves, piston type, size, in.	12
Maximum travel, in.	7¼
Steam lap, in.	1¾
Exhaust clearance, in.	3/16
Lead, in.	¼
Boiler:	
Type	Conical
Steam pressure, lb. per sq. in.	250
Diameter, first ring, outside, in.	86
Diameter, largest, outside, in.	96
Firebox length, in.	127⅛
Firebox width, in.	102¼
Combustion chamber length, in.	60
Tubes, number and diameter, in.	49—2¼
Flues, number and diameter, in.	198—3½
Length over tube sheets, ft. and in.	21—6
Fuel	Oil
Grate area, sq. ft.	90.4
Heating surfaces, sq. ft.:	
Firebox, total	350
Tubes and flues	4,502
Evaporative, total	4,852
Superheating	2,086
Comb. evap. and superheat	6,938
Feedwater heater, type	Worthington
Tender:	
Type	Rectangular
Water capacity, gal.	22,000
Fuel capacity, gal.	6,275
Trucks	6-wheel
Journals, dia. and length, in.	7×14
General data, estimated:	
Rated tractive force, engine, 83 per cent boiler pressure, lb.	62,200
Rated tractive force, booster	12,510
Total rated tractive force	74,710
Weight proportions:	
Weight on drivers ÷ weight engine, per cent	59.2
Weight on drivers ÷ tractive force	4.28
Weight of engine ÷ comb. heating surface	64.63
Boiler proportions:	
Firebox heat. surface, per cent evap. heat. surface	7.21
Tube-flue heat. surface, per cent comb. heat. surface	64.9
Superheat. surface, per cent evap. heat. surface	30.07
Firebox heat. surface ÷ grate area	3.87
Tube-flue heat. surface ÷ grate area	49.8
Superheat. surface ÷ grate area	23.08
Comb. heat. surface ÷ grate area	76.75
Tractive force, engine ÷ grate area	688.05
Tractive force, engine ÷ comb. heat. surface	8.97
Tractive force, engine × dia. drivers ÷ comb. heat. surface	658.94

Partial List of Equipment and Materials on the Southern Pacific 4-8-4 Type Locomotives

Engine bed castings; engine and trailer trucks	General Steel Castings Corp., Eddystone, Pa.
Front drawhead castings	National Malleable & Steel Casting Co., Cleveland, Ohio
Trucks and boxes for tender	Buckeye Steel Castings Co., Columbus, Ohio
Springs	American Locomotive Company, Railway Steel Spring Division, New York
Snubber springs	Cardwell Westinghouse Co., Chicago
Wheels	Edgewater Steel Co., Pittsburgh, Pa.
Driving wheels, Boxpok	General Steel Castings Corp., Eddystone, Pa.
Axles	Standard Steel Works Co., Burnham, Pa.
Spring washers	National Lock Washer Co., Newark, N. J.
Bearings	Magnus Co., New York
Radial buffer	Franklin Railway Supply Co., New York
Unit safety drawbar	Franklin Railway Supply Co., New York
Hand brake and rear draft gear	W. H. Miner, Inc., Chicago
Foundation brake	American Steel Foundries, Chicago
Air brake	Westinghouse Air Brake Co., Wilmerding, Pa.
Hose	Quaker City Rubber Co., Philadelphia, Pa.
Brake shoes	American Brake Shoe & Foundry Co., New York
Power reverse gear	American Locomotive Co., New York
Boiler steel	Lukens Steel Co., Coatesville, Pa. Otis Steel Co., Cleveland, Ohio
Boiler and cylinder jacket	American Rolling Mill Co., Middletown, Ohio
Staybolt iron	Ulster Iron Works, Dover, N. J.
Staybolts	Flannery Bolt Co., Bridgeville, Pa.
Tubes	Globe Steel Tubes Co., Milwaukee, Wis.
Smokebox netting	W. S. Tyler Company, Cleveland, Ohio
Front-end hinges	Okadee Company, Chicago
Feedwater heater	Worthington Pump and Machinery Corp., Harrison, N. J.
Superheater and Tangential dryer	Superheater Company, New York
Steam-heat equipment	Vapor Car Heating Co., Inc., Chicago
Steam-pipe casing, Reid	Lima Locomotive Works, Inc., Lima, Ohio
Insulation	Johns-Manville Sales Corp., New York
Gages	Ashton Valve Co., Cambridge, Mass.
Valves for superheated steam	Walworth Company, New York
Injector checks	Nathan Mfg. Co., New York
Bushings, Valve chamber	Hunt-Spiller Mfg. Corp., Boston, Mass.
Floating-bushing rod bearings	Hunt-Spiller Mfg. Corp., Boston, Mass.
Fusible plugs	Nathan Mfg. Co., New York
Bronze piston packing rings	Locomotive Finished Material Co., Atchison, Kan.
Piston-rod and valve-stem packing	Paxton Mitchell Co., Omaha, Neb.
Valve pull rings; Duplex sectional packing rings	Hunt-Spiller Mfg. Corp., Boston, Mass.
Grease cellars	Franklin Railway Supply Co., New York
Force-feed and hydrostatic lubricators	Nathan Mfg. Co., New York
Lubrication, Rod and motion work	Alemite Corp., Chicago
Flexible joints on steam-heat, oil and oil-heater lines, McLaughlin	Franklin Railway Supply Co., New York
Multiple throttle	American Throttle Co., Inc., New York
Booster	Superheater Company, New York
Signal Foam-meter	Electro Chemical Engineering Corp., Chicago
Headlight and generator	Pyle National Co., Chicago
Sanders	Viloco Railway Equipment Co., Chicago
Valve Pilot	Valve Pilot Corporation, New York
Bell ringers	Transportation Devices Corp., Indianapolis, Ind.
Whistles, steam	Consolidated Ashcroft-Hancock Co., Inc., Bridgeport, Conn.

practice of the builder. The back end of the main rod and the intermediate side-rod connections are fitted with floating bushings, having fixed bushings of Hunt-Spiller gun iron. The bearings on the front and back crank pins are fixed bushings. The locomotives are fitted with the Walschaert valve gear having a maximum travel of 7¼ in. They are equipped with the Alco reverse gear and the Valve Pilot for cut-off control. In order to prevent hooking up to a cut-off of less than 25 per cent the quadrant from this point to the center is blanked. The valve-motion parts are of medium steel like the running gear and crank pins, with the exception of the eccentric rod and radius bar which are of mild steel.

The rods and valve motion have Alemite fittings in the grease cups. Driving boxes are fitted with Franklin grease-lubricated cellars, and the cellars on engine- and trailer-truck journals are waste packed for oil lubrication. The cylinders and valves are lubricated from a Nathan eight-feed force-feed lubricator, type DV4, of 20 pints capacity. In addition to the valve and cylinder feeds two feeds lead to each guide. A Nathan Model 1918 hydrostatic lubricator with three feeds is provided for the booster cylinders, the hot-water feed pump and the steam cylinders of the air compressors.

Boiler Mountings

There are two cab turrets. That for saturated steam is on the right side and supplies the injector, the hydrostatic lubricator, the steam heat and the emergency connection for the reverse gear. On the left side is the superheated-steam turret from which steam is supplied to the feedwater pump, the air compressors, the booster, the oil-burner manifold, the Pyle-National turbo-generator and the blower.

Concealed within the cowling over the top of the boiler are the turrets and the headlight turbo-generator. The safety valves and the whistle, the latter disposed horizontally, are placed in wells, open at the top. The top of the dome cover is accessible through a hatch in the cowling and the sandbox occupies a rectangular space built into the cowling, which has a capacity for 2,000 lb. of sand. The smoke lifter around the stack is completely open at the front and top.

In addition to the steam whistle the locomotives have Typhon air whistles which are mounted over the top and at the front of the smokebox.

Unlike many recently built locomotives the two cross-compound air compressors on each of these engines are mounted on the left side of the boiler, partially concealed under the running-board apron. The bell is placed under the smokebox, to the bottom of which it is attached.

The Tender

The tender is of the rectangular type and is designed in cross-section to conform with the exterior of the coaches of the train. It is built up on a cast-steel water-bottom underframe. The tank has a capacity of 22,000 gallons of water and carries 6,275 gallons of fuel oil. The tender is carried on Buckeye six-wheel trucks with 7-in. by 14-in. journals.

The schedule for the Daylight trains will be considerably accelerated over the present running time. The trains will operate over the Southern Pacific Coast Line via San Luis Obispo, a line which has a maximum grade of 2.2 per cent, with grades of 1 per cent over a large part of the run. The trains now being built will be of lightweight construction, with six of the coach body units articulated into three pairs and the remaining six cars each an independent vehicle. Exclusive of the locomotives, the train will weigh 1,187,500 lb. and will be 870 ft. long. It was the need to haul these trains at high speeds under the difficulties imposed by the line that led to the development of a locomotive possessing both high tractive force and the ability to make high speeds on level track.

The general dimensions and weights are given in the table.

Venetian Blinds For Passenger Cars

The accompanying interior view of the lounge car on the "Mercury," the New York Central streamlined steam train, illustrates the adaptation of Ventilighter Venetian blinds on railroad passenger cars. Rattling of these blinds at the high speeds attained by streamlined trains is prevented by design features which include channel-type side guides with a center rubber strip so devised that the slats are snubbed in all positions of angular adjustment. The side channel guides in which the slats are raised and lowered are made of 16-gage aluminum, and are secured with machine screws to the frame of the window. The exposed faces of the guides are finished to match the interior trim of the car.

This Ventilighter blind, which is manufactured by the Simon Ventilighter Company, Inc., New York, N. Y., is an assemblage of parallel ⅛-in. by 1¾-in. cedar slats located on 1½-in. centers, and pivotally suspended in 1½-in. cloth ladder tape fastened to a concealed overhead shaft of aluminum. This shaft has a diameter of

Ventilighter Venetian Blinds on the Lounge Car of the "Mercury"

¾ in. and is attached to the car frame by friction clamping brackets of the brake-band type. By tilting the shaft, the tapes, and the slats suspended therefrom, any angular position of the slats is obtained. Tilting is accomplished by means of tasselled pull cords, or by a knobbed lever attached to the shaft.

The blinds are operated by two controls, one for tilting the angle of the slats as previously described, and one for raising and lowering. The raising and lowering cords are designed to bring the vanes horizontal, eliminating unnecessary friction in lifting the blind. By eliminating the conventional worm-gear tilt used with Venetian blinds, and using the friction brake principle previously referred to, the head construction of the Ventilighter is such that it raises clear of the interior frame of a double-sash window. This makes it possible to use hinged or removable interior sashes, which can be moved without disturbing the blind when cleaning these sashes.

Failures of

Locomotive Parts*

By F. H. Williams†

THE two previous articles in this series have dealt with the failures of piston rods through the taper section which fits in the crosshead, or in the fillet between the shank of the rod and the tapper end. It is the purpose of this article to point out additional causes of failures in the taper section of the rod and to summarize the points brought out in the three articles.

The finish of the keyway of a piston rod is of extreme importance. The edges of all keyways should be rounded off with suitable radii, in proportion to the size of the rod and the keyway. These edges must not be beveled or chiseled, but must have a polished, rounded finish, without nicks or breaks. A properly finished edge on a keyway is "a thing of beauty and a joy forever."

There are many ways in which a shopman can get a good finish, with a proper radius, quickly and at a reasonable cost when compared to having to provide a new piston rod every year or two.

Another cause of failure is chargeable to the leaving of pock or punch marks, which were used in laying out the keyway. These should in all cases be removed and this, of course, can only be done by eliminating them in the process of cutting the keyway and rounding off the sharp edges.

It is often the practice when making the keyway to drill three or more holes and then mill or chisel out the remaining metal. Any defect is, of course, hidden from sight when the piston rod is keyed to the crosshead. This in a way is unfortunate, since it is impossible to check up by inspection after the assembly is made.

Occasionally the holes are drilled off center, halfway through the rod, and the hole is then completed by drilling from the opposite side. This leaves a ridge at the center of the keyway, which may start a fatigue crack and cause a failure. I do not know why it is that the drill, properly started, should run off to one side; unless possibly it is because it has not been properly sharpened. This, also, will cause torn walls in the drilled hole, the effects of which may not be removed by the subsequent machining and finishing process and may cause fatigue cracks.

Radiographs which were made of the walls of piston-rod keyways showed change in the density of the steel along the axis of the drilled holes caused by the drilling of the holes, even though the metal had been milled out after the drilling; in other words, the wall of the drilled hole was so torn and work-hardened that the metal was badly distorted and the effects were not entirely removed by the subsequent milling operation.

Tool marks, tears, corrosion and other irregularities when associated with reverse stresses are almost sure to cause fatigue cracks and failure. Stress-corrosion naturally starts much more quickly with a rough surface than with a polished one. It is said that corrosion and tool marks, in conjunction with reverse stresses, will reduce the strength of a part by as much as 50 to 60 per cent. This is something for the designer to think about in making his calculations.

Another difficulty is that the designer may not recognize the importance of indicating the small radii to designate the rounding of the edges of the keyway, and quite naturally, the mechanic will not feel called upon to round off these corners if the drawing does not so designate.

Sometimes a keyway may be worn in service and the edges burred, especially near the ends, which with a little careful workmanship could be made as good as new. It may be placed back in the crosshead, however, without this work being done. The key may perhaps ride to one side and thus place an unnecessary strain upon that portion of the rod, and overstress a section which may lack the proper finish and be subject to the development of fatigue cracks.

Instances have been known of keyways on which the oxy-acetylene torch was used to remove surplus metal. No one was the wiser until the rod failed and investigation brought to light the fact that the torch had been used.

Another detail which must not be overlooked is the construction of the key itself. It was the practice formerly to forge these keys to shape from pieces of old steel tires. This practice was changed by purchasing steel similar to tire steel but rolled into bars to nearly the required size. It is only necessary to shape them to the exact size and then heat treat the material, thus insuring high tensile strength and toughness. Complaints were made at one time that some keys were not standing up as they should. Investigation revealed the fact that the heat treatment had been omitted. The difficulty was promptly overcome when the shop forces understood the importance of dealing with the new material properly.

With these introductory remarks as a background, illustrations will be shown of rods which were improperly finished and which failed. Fig. 1, for instance, is a rather extreme case, but shows a rod which was scrapped for defects. The keyway was off center, causing the key to bear on one side and displacing the metal at the end to such an extent that it could not fit the crosshead properly. Stresses were apparently concentrated just above the keyway and stress-corrosion cracks were started. While this was the primary cause of the failure, the sharp edges of the keyway and the punch marks were also potential sources of failure.

A piston rod which failed through the taper fit, primarily because of the sharp edges of the keyway, is shown in Figs. 2 and 3. It will be noted, also, that the material was badly chafed or worn near the edges of the keyway. The point where the difficulty started, at one side of the keyway, is clearly indicated by the fatigue crack nucleus in Fig. 3.

The piston rod shown in Fig. 4 was scrapped because of the crack *X—X*. Here again, the edges of the keyway were not rounded off and the chafed material indicates that the rod was not properly fitted in the crosshead. The fatigue crack started from the edge of the drilled hole in the end of the keyway, the conditions apparently being complicated by the poor fit, which caused an abrasion or flow of surface metal. These poor fits have been largely overcome by using the plug-and-collar gages mentioned in the previous article, and thus standardizing the taper for the fit. It will be noted also from the photograph, that the edges of the keyway at the ends are badly burred. By working with the gages

* Part 9 of an article which began in the May, 1936, issue.
† Assistant test engineer, Canadian National Railways.

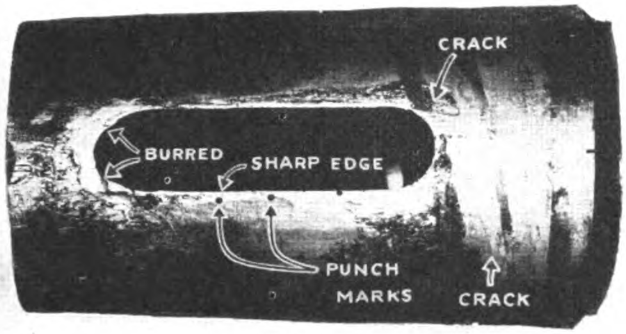


FIG. 1

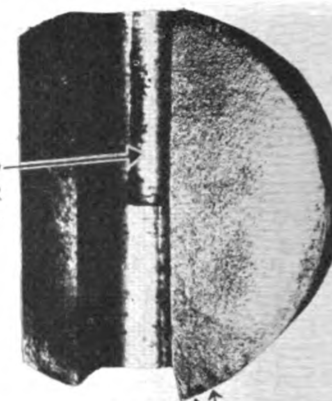


FIG. 3

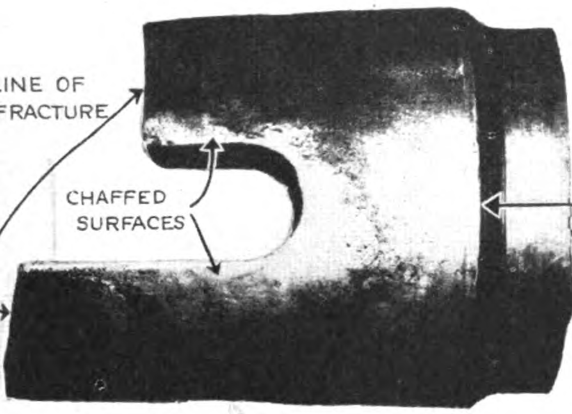


FIG. 2

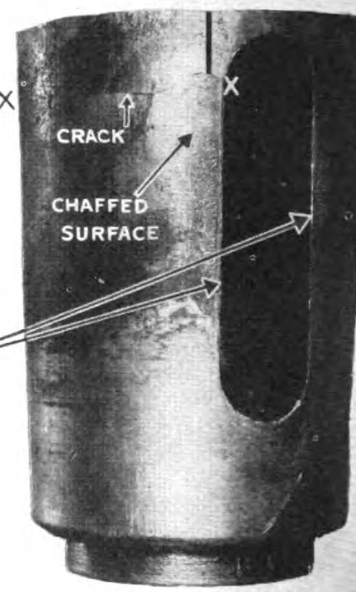


FIG. 4

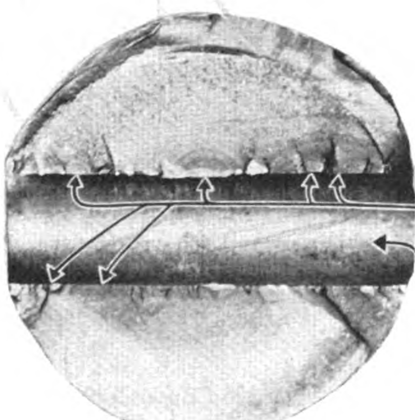


FIG. 5

FIG. 6

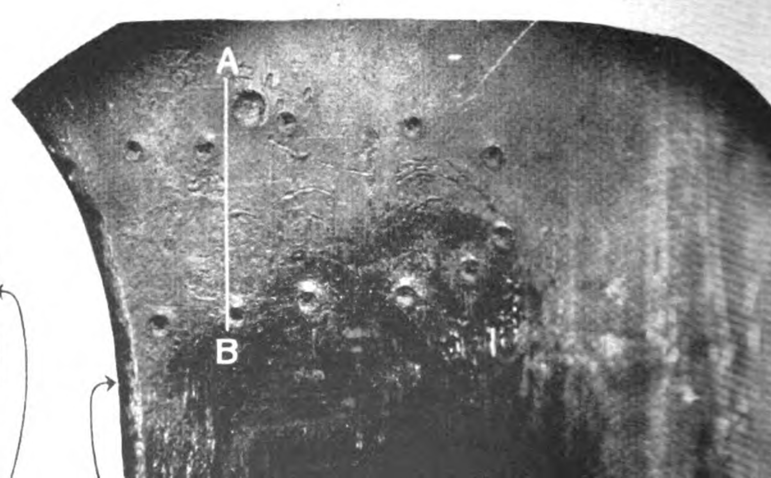


FIG. 7

FIG. 8

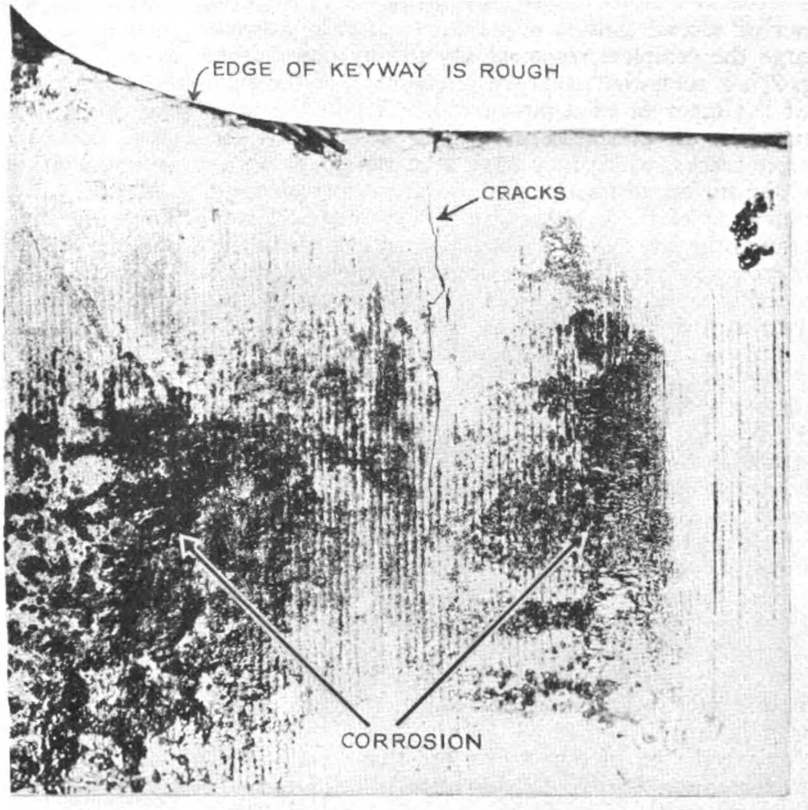


FIG. 11

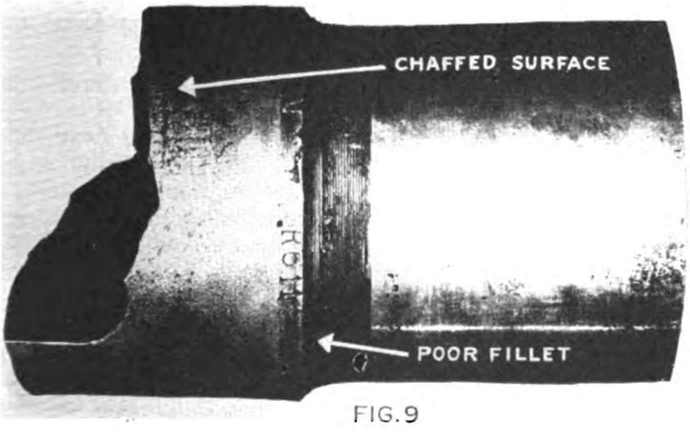


FIG. 9

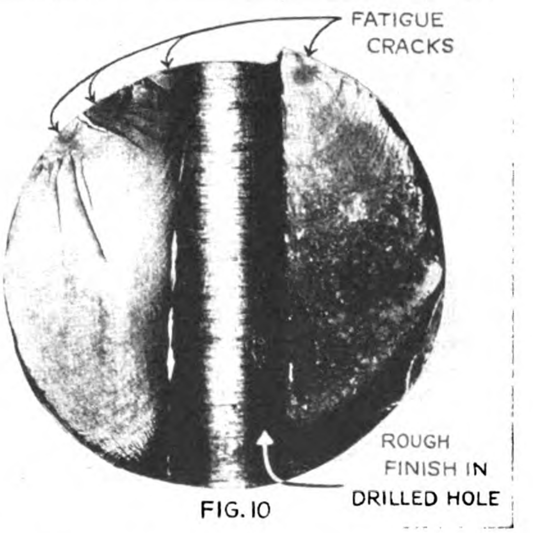


FIG. 10

Fig. 8—Cross section (enlarged) of the piston rod through section *A-B*, Fig 7. Note the cracks extending inward from the surface of the taper fit of the piston rod. Fig. 9—Fatigue cracks started from the rough surface on the taper fit of the piston rod. Fig. 10—Fractured end of the piston rod shown in Fig. 9, which failed in service. Fig. 11—Enlarged view of the surface of a piston rod which failed in the taper fit. Note the rough edges of the keyway and the corrosion, which is indicated by the dark areas.

ig. 1—Taper end of a piston rod which was scrapped because of the lefects noted. Fig. 2—Piston rod which broke through taper fit. Note that the material is badly chafed alongside the edges of the keyway. Fig. 3—Fractured end of the piston rod shown in Fig. 2. The atigue crack started in the chafed section. Note that the hole in the end of the keyway was drilled off center. Fig. 4—Piston rod which was scrapped because of the crack *X—X*. Fig. 5—Badly drilled hole t the end of a keyway of a piston rod which failed in service. Fig. 6 —Side view of the taper end of the piston rod, the fractured face of which is shown in Fig. 5. Fig. 7—Enlarged view of the surface of the taper fit of a defective piston rod. Note the surface cracks in the area within the punch marks

and to a standard taper, this condition has largely been done away with.

An excellent example of the effects of badly drilled holes at the ends of keyways is shown in Figs. 5 and 6. It will be seen that the fatigue cracks, and there are many of them, all start from the walls of the drilled hole. The roughnesses or tears in the wall of the drilled hole do not appear quite as clearly as they should, because in the endeavor to focus on the fatigue cracks, the wall at the end of the keyway was thrown a little out of focus. The band of rust or corrosion, in Fig. 6, is evidence of a poorly fitted rod, and this may have been a factor in concentrating excessive reverse stresses on the walls of the drilled hole, although the band of rust may have resulted because of the rod working after the fatigue

cracks were well under way. Obviously, where there is evidence of several sources of weakness, it is impossible to charge the complete responsibility to any one defect.

Fig. 7 is a somewhat enlarged photograph of the surface of the taper fit of a piston rod. Within the area designated by the punch marks, will be noted a number of surface cracks, which may have been caused by abrasion of the surface of the material, or stress-corrosion, or a combination of these two causes. This material was cut through the line A-B, and Fig. 8 is an enlarged view of this cross section. While the appearance of the cracks in the photographs might indicate that they were caused by stress-corrosion, yet the area is one in which such cracks are not usually found, and they may have been caused by the abrasion of the crosshead, because of the poor fit of the rod. A properly machined and fitted rod would have eliminated both of these causes.

The abrasion or corrosion on a rod which failed, is clearly evident in Fig. 9. It will be noted from the cross section of this break that there were a number of fatigue cracks, which started from the rough surface. The hole at the end of the keyway was also roughly drilled and might have caused the failure. It will be seen that the fillet between the shank of the rod and the tapered section is rough machined only. It is only fair to say that this is an unusual condition and such practice would not now be tolerated. The fractured end of this piston rod is shown in Fig. 10.

An enlarged view of a part of a rod that was cracked is shown in Fig. 11. Here, again, it is difficult to indicate the exact cause of the failure. The edge of the keyway is rough and almost sharp. The taper fit of the rod was rough machined. One crack started at the edge of the keyway, while the other cracks are more or less in line with it on the rough machined surface. The photograph also indicates considerable corrosion due to the loose or improper fitting of the rod in the crosshead. The crack, however, is removed from the worst portion of the abraded surface, so that corrosion was probably not an important factor in this case in causing the cracks.

Summary

This article and the two which preceded it in the January and February numbers of the *Railway Mechanical Engineer,* have illustrated broken rods, or defects which have required the scrapping of the rod. Outstanding failures in the tapered section of the piston rod are:

Stress-corrosion cracks—These usually occur just inside the crosshead fit on the rod, about ½ in. to ¾ in. from the end of the keyway. The corrosion is caused by the steel rubbing under compression (frictional corrosion).

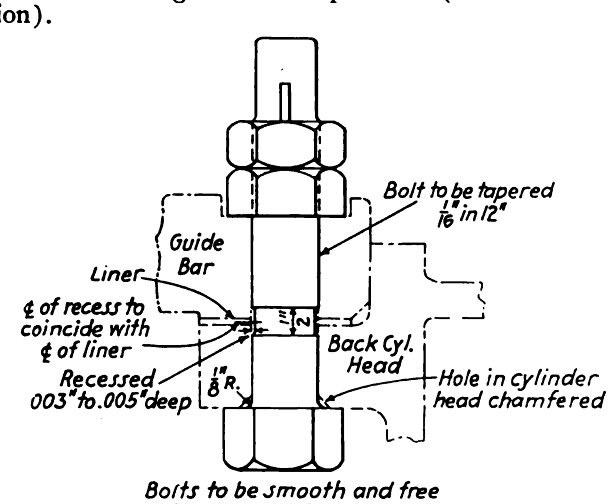


Fig. 12—Undercutting as applied to guide-bar bolts

Cracks starting from tool marks—These are due to grooves on the surface caused by improperly sharpened tools.

Cracks starting from cold-worked surfaces—These are caused by using the wrong taper, allowing the rod to chafe in the crosshead fit. They are usually located around the keyway and just inside the crosshead.

Cracks starting from sharp edges of the keyway—These usually occur between the center of the keyway and the end toward the larger diameter of the taper.

Cracks starting from punch marks—These punch marks are used in laying out the keyway and occasionally are not removed by the machining operations. Such a crack occasionally starts from letters or numbers which are stamped on the taper fit at its large end.

Cracks starting from roughly drilled holes—These cracks start in the walls of the drilled hole.

Cracks starting from holes drilled off center—These are much the same as those for the roughly drilled holes above mentioned.

Cracks starting from roughly milled keyways—These, of course, are in the side walls of the keyway.

Cracks starting from corrosion bands—The corrosion bands are caused by a poor fit or wrong taper of the piston rod in the crosshead. This may be due to pressure (frictional corrosion) or to atmospheric corrosion.

All of the above-mentioned causes of failure may be largely eliminated by more careful workmanship.

Recommendations

Summing up the three articles on piston-rod failures, the following practices are commended:

1—The taper fits of piston rods to the crossheads should be carefully and accurately made, with the aid of master plugs and master collars.

2—The taper fits on piston rods should be finished free from all tool marks and scores.

3—The edges of the keyways should be rounded with proper radii.

4—The drilled holes used in making the keyway should be cut smooth; if not, they should be carefully reamed or milled in order to eliminate rough and torn surfaces.

5—Punch marks around the edges of the keyways should be eliminated; obviously, this will automatically be done when the edges of the keyway are rounded off, unless an error is made and the keyway is wrongly located.

6—Burrs at the ends of the keyways should not be tolerated.

7—Undercuts of proper width and diameter should be made on the taper fit of the piston rods, between the edge of the crosshead and the keyway. A suggested method of doing this was illustrated in the article in the *Railway Mechanical Engineer* of January, 1937, page 19. A similar practice in the application of guide-bar bolts is illustrated in Fig. 12. The undercutting should be made from ¼ in. to ½ in. wide and from .003 in. to .005 in. in depth. It should lie between the end of the keyway and the taper fit within the crosshead. This undercutting should have proper fillets at both ends and must be polished and free from scratches. If this band is rolled instead of undercut, care must be taken to free the surface from all tool marks and torn metal before the rolling is done. As indicated in the previous article, this undercutting is done to prevent stress-corrosion cracks.

These comments on undercutting apply also to axles and practically all press fits where the surfaces under pressure are subject to reverse stresses. The author has known of shafts failing just inside the collar because of stress-corrosion.

Remember that a perfect fit is a lasting fit.

Diesel-Electric Locomotive

Projected Repair Costs

Projected repair costs over a twenty-five-year period for an 800-hp. Diesel-electric locomotive. Includes itemization of parts replaced, labor hours, material costs and labor charges

In 1932 the Northampton & Bath, which operates between Northampton, Pa., and Bath Junction, Pa., over a rolling profile with a maximum grade 1.8 per cent for approximately 2,500 ft. and an equivalent grade of about 1 per cent against heavy traffic, decided to use only Diesel-electric locomotives. This decision was based upon performance of Diesel-electric equipment as guaranteed by the manufacturers, and the evident economies of operation derived through a comprehensive study by the road's engineering department of available data.

In determining operating costs of Diesel-electric motive power it was decided to break them down into six major expenses, viz., wages, fuel, lubrication, supplies, enginehouse expense and repairs. Of these, all may be more or less readily determined from actual records, with the exception of repair costs, which fluctuate from month to month, year to year and with light and heavy overhauls. It is a well-known fact that steam locomotive repair costs rise with the locomotive age, and it may be expected that Diesel-electric locomotive repair costs will rise in a similar manner but at a lower rate of increase. It became essential in preparing the data given herein to determine the actual repair costs over a period of years if a real measure of savings were to be ascertained.

It has been fairly well established that Diesel-electric locomotive repairs are divided into three major divisions:

1. Mechanical repairs covering trucks, engineman's and engine room cabs, air-brake equipment and miscellaneous mechanical auxiliary equipment.
2. Electrical repairs covering traction motors, generators, control equipment, etc.
3. Diesel repairs covering the Diesel units together with their major intimate auxiliaries.

Straight electric operation has determined the economic life of the equipment listed under the mechanical and electrical divisions. However, the life of Diesel units is still subject to argument, inasmuch as Diesel-electric locomotives have not been in service long enough for the compilation of records showing actual repair costs over a long period of time.

Therefore, in compiling the repair cost presented herein it was thought that if the repair-cost trend curve for straight electric locomotives could be determined, and

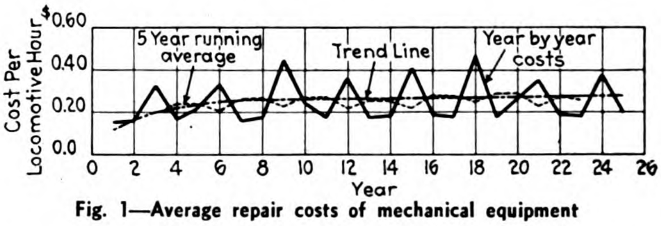


Fig. 1—Average repair costs of mechanical equipment

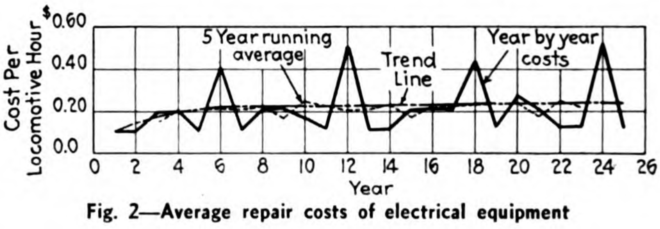


Fig. 2—Average repair costs of electrical equipment

Table I—Twenty-Five-Year Projected Repair Costs for an 800-Hp. Diesel Electric Locomotive

FIRST YEAR—7,000 HRS.

	Material cost	Labor hours
Mechanical:		
Air compressors (prorated)	$40	30
Air brake equipment (prorated)	30	40
True tires (twice a year)	....	60
Brake shoes (6 sets)	120	....
Hub liners	215	50
Sanders (prorated)	4	8
Window wipers	4	....
Annual maintenance	50	660
	463	848
Electrical:		
Traction motors:		
Brushes	25	....
Armature and field coils (prorate units one motor)	100	20
Canvas bellows	3	10
Generator:		
Brushes	20	..
Exciters:		
Brushes	5	..
Wiring.		
Power and control (prorated)	50	25
Control:		
Miscellaneous fixtures	100	..
Air compressor motors:		
Miscellaneous	20	..
Annual maintenance	30	480
	353	535
Diesel engines:		
Rings	60	132
Valve grinding and reseating (twice per year)	50	300
Gears (prorated)	40	....
Miscellaneous gaskets	20	....
Miscellaneous ball bearings (prorated)	20	....
Miscellaneous springs	10	....
Annual maintenance	110	840
	310	1,272
Totals	1,126	2,655
Labor cost at 68 cents per hour	1,805.40	....
Annual total cost	2,931.40	....
Annual cost per hour	0.419	....

SECOND YEAR—14,000 HRS.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	848
14,000 hrs.:		
Foot board (wood)	5	12
Arm rests	10	5
Air hose	5	....
	20	17
Increase annual maintenance, labor	....	17
Electrical:		
7,000 hs.	353	535
14,000 hrs.	None	None
Increase annual maintenance, labor	....	12
Diesel engines:		
7,000 hrs.	310	1,272
14,000 hrs.:		
Renew atomizer nozzles and needles	120	....
	120	....
Increase annual maintenance, labor	....	21
Totals	1,266	2,722
Labor cost at 68 cents per hour	1,850.96	....
Annual total cost	3,116.96	....
Annual cost per hour	0.445	....

THIRD YEAR—21,000 HRS

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	793
21,000 hrs.:		
New tires, polish journals and reface wheel hubs	420	250
Coupler knuckles	12	1
Rebabbitt brasses	75	....
Seat cushions	10	5
Brake-pipe strainer	5	5
Cleaning miscellaneous truck parts	10	140
Miscellaneous truck repairs	....	140
Jacking cab up and down	20	175
Partial dissembly and assembly of trucks	30	275
	582	991
Increase annual maintenance, labor	....	33
Electrical:		
7,000 hrs.	353	495
21,000 hrs.:		
Light wiring	20	80
Traction motors:		
Miscellaneous plates, leads and bolts, etc.	80	40
Armature bearings	300	....
Dissemble and assemble	20	200
	420	320
Increase annual maintenance, labor	....	24
Diesel engines:		
7,000 hrs.	$285	1,052
21,000 hrs.:		
Dissemble and assemble	100	450
New pistons	1,020	....
New liners	600	....
Connecting-rod bearings	80	20
Push rods, etc.	210	....
Polish and true up crank pins	120	50
Puralators	20	....
Cylinder-head water connections	30	24
	2,180	544
Increase annual maintenance labor	....	42
Totals	4,283	4,294
Labor cost at 68 cents per hour	2,919.92	....
Annual total cost	7,202.92	....
Annual cost per hour	1.029	....

FOURTH YEAR—28,000 HRS.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	848
14,000 hrs.	20	17
28,000 hrs.	....	....
Hot-water piping and expansion tank	20	20
	20	20
Increase annual maintenance, labor	....	50
Electrical:		
7,000 hrs.	353	535
14,000 hrs.	None	None
28,000 hrs.	....	....
Battery	650	50
	650	50
Increase annual maintenance, labor	....	36
Diesel engines:		
7,000 hrs.	310	1,272
14,000 hrs.	120	....
28,000 hrs.:		
Fuel-pump spline and shaft assembly	250	40
Timing-governor assembly	150	....
Fuel pipes	150	....
	550	40
Increase annual maintenance, labor	....	63
Totals	2,486	2,931
Labor cost at 68 cents per hour	1,993.08	....
Annual total cost	4,479.08	....
Annual cost per hour	0.64	....

FIFTH YEAR—35,000 HRS.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	848
35,000 hrs.:		
Coupler body	40	8
Draft-gear springs	10	12
Brake clevis	15	60
Side bearings	15	20
Brake-rigging pins and turnbuckles	75	....
Clean, paint, varnish and letter inside and outside of cab	100	150
	255	250
Increase annual maintenance, labor	....	66
Electrical:		
7,000 hrs.	353	535
35,000 hrs.	None	None
Increase annual maintenance, labor	....	48
Diesel engines:		
7,000 hrs.	310	1,272
35,000 hrs.:		
Renew valve springs	110	....
Renew valve guides	240	30
Renew fuel-pump plungers and bodies	360	....
Renew water-pump impeller	20	....
Renew water-pump shaft and bearing assembly	40	....
Fuel booster and scavenger pump and couplings	60	....
Renew valves	432	150
	1,262	180
Increase annual maintenance, labor	....	84
Totals	2,643	3,283
Labor cost at 68 cents per hour	2,232.44	....
Annual total cost	4,875.44	....
Annual cost per hour	0.696	....

SIXTH YEAR—42,000 HRS.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	793
14,000 hrs.	20	17
21,000 hrs.	582	991
42,000 hrs.	None	None
Increase annual maintenance, labor	....	82

(Table continued on opposite page)

to this curve the estimated Diesel engine costs added, the total would represent the Diesel-electric repair trend. A careful examination of straight electric locomotive repair costs showed that costs relative to repairs of parts of equipment of straight electric locomotives not common to Diesel-electric locomotives could not be separated readily from the available figures for straight electric locomotive maintenance. Therefore, this method

Table I — Twenty-Five-Year Projected Repair Costs (Continued)

	Material cost	Labor hours
Electrical:		
7,000 hrs.	$353	495
14,000 hrs.	None	None
21,000 hrs.	400	120
42,000 hrs.:		
Traction motors:		
Pinions	70	16
Commutators slotting, turning, dipping, banding and baking	700	40
Axle bearings	220	....
Generators:		
Dissemble and assemble	....	80
Commutator slotting, turning, dipping, banding and baking	400	20
Exciters:		
Dissemble and assemble	....	10
Commutator slotting, turning, dipping, banding and baking	150	10
	1,540	176
Increase annual maintenance, labor	....	60
Diesel engines:		
7,000 hrs.	285	1,052
14,000 hrs.	120	....
21,000 hrs.	2,180	544
42,000 hrs.:		
Renew vibration discs	50	....
Renew rocker-arm bearings	60	....
Renew fuel-pump straps	180	....
Renew lub. gov. and scavenger-pump gear and shafts	100	....
Renew tappet plungers, guides, springs and roller bushings complete	300	50
Crankshaft bearings	380	....
	1,070	50
Increase annual maintenance, labor	....	105
Totals	7,013	4,485
Labor cost at 68 cents per hour	3,049.80	....
Annual total cost	10,062.80	....
Annual cost per hour	1.438	....

Seventh Year—49,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	848
49,000 hrs.	None	None
Increase annual maintenance, labor	....	99
Electrical:		
7,000 hrs.	353	535
49,000 hrs.	None	None
Increase annual maintenance, labor	....	72
Diesel engines:		
7,000 hrs.	310	1,272
49,000 hrs.:		
Nugent strainer baskets	50	....
	50	....
Increase annual maintenance, labor	....	126
Totals	1,176	2,952
Labor cost at 68 cents per hour	2,007.36	....
Annual total cost	3,183.36	....
Annual cost per hour	0.455	....

Eighth Year—56,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	848
14,000 hrs.	20	17
28,000 hrs.	20	20
56,000 hrs.	None	None
Increase annual maintenance, labor	....	116
Electrical:		
7,000 hrs.	353	535
14,000 hrs.	None	None
28,000 hrs.	650	50
56,000 hrs.	None	None
Increase annual maintenance, labor	....	84
Diesel engines:		
7,000 hrs.	310	1,272
14,000 hrs.	120	....
28,000 hrs.	550	40
56,000 hrs.	None	None
Increase annual maintenance, labor	....	147
Totals	2,486	3,129
Labor cost at 68 cents per hour	2,127.72	....
Annual total cost	4,613.72	....
Annual cost per hour	0.659	....

Ninth Year—63,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	793
21,000 hrs.	552	716
63,000 hrs.:		
Trucks:		
Axles	300	60
Complete dissembly and assembly of trucks	50	450
Pedestal shoe	20	24
Springs retemper	100	....
Spring hangers	80	....
Spring-hanger pins	20	....
Spring-hanger keys	20	....
Brake heads	20	....
King bolt	20	....
	630	534
Increase annual maintenance, labor	....	132
Electrical:		
7,000 hrs.	$353	495
21,000 hrs.	420	320
63,000 hrs.:		
Generators:		
Bearings	100	20
	100	20
Increase annual maintenance, labor	....	96
Diesel engines:		
7,000 hrs.	285	1,052
21,000 hrs.	2,180	544
63,000 hrs.:		
Wrist pins and wrist-pin bushings	150	16
Cam-shaft bearings	220	....
Valve seats renew	240	50
Radiators	1,200	20
Cooling-water tanks and piping	200	....
	2,010	86
Increase annual maintenance, labor	....	168
Totals	6,993	4,956
Labor cost at 68 cents per hour	3,370.08	....
Annual total cost	10,363.08	....
Annual cost per hour	1.48	....

Tenth Year—70,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	848
14,000 hrs.	20	17
35,000 hrs.	255	250
70,000 hrs.:		
Bell ringer	10	5
Headlight reflectors	20	....
Brake-pipe cut-out cocks	20	10
Engineman's cab floor (wood)	10	40
	60	55
Increase annual maintenance, labor	....	148
Electrical:		
7,000 hrs.	353	535
14,000 hrs.	None	None
35,000 hrs.	None	None
70,000 hrs.:		
Booster fuel-pump motors	50	....
Scavenger fuel-pump motors	50	....
Radiator blower motors	75	....
Traction motor blowers	200	....
	375	....
Increase annual maintenance, labor	..	108
Diesel engines:		
7,000 hrs.	310	1,272
14,000 hrs.	120	....
35,000 hrs.	1,262	180
70,000 hrs.:		
Water-pump bodies	24	10
Cuno strainers	50	....
Mufflers	40	....
	114	10
Increase annual maintenance, labor	....	189
Totals	3,332	3,612
Labor cost at 68 cents per hour	2,456.16	....
Annual total cost	5,788.16	....
Annual cost per hour	0.827	....

Eleventh Year—77,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	848
77,000 hrs.	None	None
Increase annual maintenance, labor	....	165
Electrical:		
7,000 hrs.	363	535
77,000 hrs.	None	None
Increase annual maintenance, labor	....	120
Diesel engines:		
7,000 hrs.	310	1,272
77,000 hrs.	None	None
Increase annual maintenance, labor	....	210
Totals	1,126	3,150
Labor cost at 68 cents per hour	2,142.00	....
Annual total cost	3,268.00	....
Annual cost per hour	0.467	....

Twelfth Year—84,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	793
14,000 hrs.	20	17
21,000 hrs.	582	991
28,000 hrs.	20	20
42,000 hrs.	None	None
84,000 hrs.:		
Male center-plate wearing plate	25	40
	25	40
Increase annual maintenance, labor	....	182
Electrical:		
7,000 hrs.	353	495
14,000 hrs.	None	None
21,000 hrs.	400	120
28,000 hrs.	650	50
42,000 hrs.	1,540	176
84,000 hrs.	None	None
Increase annual maintenance, labor	....	132

Table 1—Twenty-Five-Year Projected Repair Costs (Continued)

	Material cost	Labor hours
Diesel engines:		
7,000 hrs.	$285	1,052
14,000 hrs.	120	....
21,000 hrs.	2,180	544
28,000 hrs.	550	40
42,000 hrs.	1,070	50
84,000 hrs.	None	None
Increase annual maintenance, labor	....	231
Totals	8,258	4,933
Labor cost at 68 cents per hour	3,354.44	....
Annual total cost	11,612.44	....
Annual cost per hour	1.659	....

Thirteenth Year—91,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	848
91,000 hrs.	None	None
Increase annual maintenance, labor	....	198
Electrical:		
7,000 hrs.	353	535
91,000 hrs.	None	None
Increase annual maintenance, labor	....	144
Diesel engines:		
7,000 hrs.	310	1,272
91,000 hrs.	None	None
Increase annual maintenance, labor	....	252
Totals	1,126	3,249
Labor cost at 68 cents per hour	2,209.32	....
Annual total cost	3,335.32	....
Annual cost per hour	0.476	....

Fourteenth Year—98,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	848
14,000 hrs.	20	17
49,000 hrs.	None	None
98,000 hrs.	None	None
Increase annual maintenance, labor	....	214
Electrical:		
7,000 hrs.	353	535
14,000 hrs.	None	None
49,000 hrs.	None	None
98,000 hrs.	None	None
Increase annual maintenance, labor	....	156
Diesel engines:		
7,000 hrs.	310	1,272
14,000 hrs.	120	....
49,000 hrs.	50	....
98,000 hrs.	None	None
Increase annual maintenance, labor	....	273
Totals	1,316	3,315
Labor cost at 68 cents per hour	2,254.20	....
Annual total cost	3,570.20	....
Annual cost per hour	0.61	....

Fifteenth Year—105,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	793
21,000 hrs.	582	991
35,000 hrs.	255	250
105,000 hrs.	None	None
Increase annual maintenance, labor	....	231
Electrical:		
7,000 hrs.	353	495
21,000 hrs.	420	320
35,000 hrs.	None	None
105,000 hrs.	None	None
Increase annual maintenance, labor	....	168
Diesel engines:		
7,000 hrs.	285	1,052
21,000 hrs.	2,180	544
35,000 hrs.	1,262	180
105,000 hrs.:		
Crankshafts	2,700	....
	2,700	
Increase annual maintenance, labor	....	294
Totals	8,500	5,318
Labor cost at 68 cents per hour	3,616.24	....
Annual total cost	12,116.24	....
Annual cost per hour	1.731	....

Sixteenth Year—112,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	848
14,000 hrs.	20	17
28,000 hrs.	20	20
56,000 hrs.	None	None
112,000 hrs.	None	None
Increase annual maintenance, labor	....	248
Electrical:		
7,000 hrs.	353	535
14,000 hrs.	None	None
28,000 hrs.	650	50
56,000 hrs.	None	None
112,000 hrs.	None	None
Increase annual maintenance, labor	....	180
Diesel engines:		
7,000 hrs.	310	1,272
14,000 hrs.	120	....
28,000 hrs.	550	40
56,000 hrs.	None	None
112,000 hrs.	None	None
Increase annual maintenance, labor	....	315
Totals	$2,486	3,525
Labor cost at 68 cents per hour	2,397.00	....
Annual total cost	4,883.00	....
Annual cost per hour	0.698	....

Seventeenth Year—119,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	848
119,000 hrs.	None	None
Increase annual maintenance, labor	....	264
Electrical:		
7,000 hrs.	353	535
119,000 hrs.	None	None
Increase annual maintenance, labor	....	192
Diesel engines:		
7,000 hrs.	310	1,272
119,000 hrs.	None	None
Increase annual maintenance, labor	....	336
Totals	1,126	3,447
Labor cost at 68 cents per hour	2,343.96	....
Annual total cost	3,469.96	....
Annual cost per hour	0.496	....

Eighteenth Year—126,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	793
14,000 hrs.	20	17
21,000 hrs.	552	716
42,000 hrs.	None	None
63,000 hrs.	630	534
126,000 hrs.	None	None
Increase annual maintenance, labor	....	280
Electrical:		
7,000 hrs.	353	495
14,000 hrs.	None	None
21,000 hrs.	400	120
42,000 hrs.	1,540	176
63,000 hrs.	100	20
126,000 hrs.	None	None
Increase annual maintenance, labor	....	204
Diesel engines:		
7,000 hrs.	285	1,052
14,000 hrs.	120	....
21,000 hrs.	2,180	544
42,000 hrs.	1,070	50
63,000 hrs.	2,010	86
126,000 hrs.	None	None
Increase annual maintenance, labor	....	357
Totals	9,723	5,444
Labor cost at 68 cents per hour	3,701.92	....
Annual total cost	13,424.92	....
Annual cost per hour	1.918	....

Nineteenth Year—133,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	848
133,000 hrs.	None	None
Increase annual maintenance, labor	....	297
Electrical:		
7,000 hrs.	353	535
133,000 hrs.	None	None
Increase annual maintenance, labor	....	216
Diesel engines:		
7,000 hrs.	310	1,272
133,000 hrs.	None	None
Increase annual maintenance, labor	....	378
Totals	1,126	3,546
Labor cost at 68 cents per hour	2,411.28	....
Annual total cost	3,537.28	....
Annual cost per hour	0.505	....

Twentieth Year—140,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	848
14,000 hrs.	20	17
28,000 hrs.	20	20
35,000 hrs.	255	250
70,000 hrs.	60	55
140,000 hrs.	None	None
Increase annual maintenance, labor	....	314

(Table continued on opposite page)

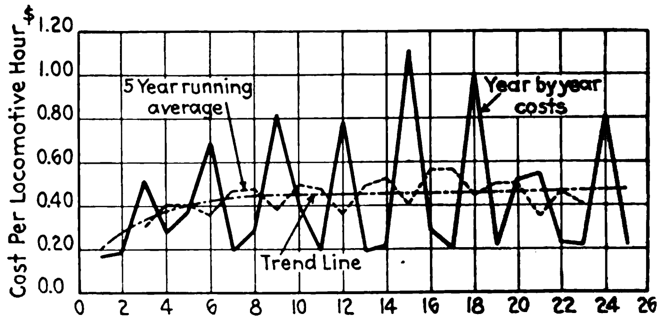


Fig. 3—Average repair costs of the Diesel engine

Table I — Twenty-Five-Year Projected Repair Costs (Continued)

	Material cost	Labor hours
Electrical:		
7,000 hrs.	$353	535
14,000 hrs.	None	None
28,000 hrs.	650	50
35,000 hrs.	None	None
70,000 hrs.	375	....
140,000 hrs.	None	None
Increase annual maintenance, labor	....	228
Diesel engines:		
7,000 hrs.	310	1,272
14,000 hrs.	120	....
28,000 hrs.	550	40
35,000 hrs.	1,262	180
70,000 hrs.	114	10
140,000 hrs.	None	None
Increase annual maintenance, labor	......	399
Totals	4,552	4,218
Labor cost at 68 cents per hour	2,868.24	....
Annual total cost	7,420.24	....
Annual cost per hour	1.06	....

Twenty-first Year—147,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	793
21,000 hrs.	582	991
49,000 hrs.	None	None
147,000 hrs.	None	None
Increase annual maintenance, labor	....	330
Electrical:		
7,000 hrs.	353	495
21,000 hrs.	420	320
49,000 hrs.	None	None
147,000 hrs.	None	None
Increase annual maintenance, labor	....	240
Diesel engines:		
7,000 hrs.	285	1,052
21,000 hrs.	2,180	544
49,000 hrs.	50	....
147,000 hrs.	None	None
Increase annual maintenance, labor	....	420
Totals	4,333	5,185
Labor cost at 68 cents per hour	3,525.80	....
Annual total cost	7,858.80	....
Annual cost per hour	1.123	....

Twenty-second Year—154,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	848
14,000 hrs.	20	17
77,000 hrs.	None	None
154,000 hrs.	None	None
Increase annual maintenance, labor	....	346
Electrical:		
7,000 hrs.	353	535
14,000 hrs.	None	None
77,000 hrs.	None	None
154,000 hrs.	None	None
Increase annual maintenance, labor	....	252
Diesel engines:		
7,000 hrs.	310	1,272
14,000 hrs.	120	....
77,000 hrs.	None	None
154,000 hrs.	None	None
Increase annual maintenance, labor	....	441
Totals	1,266	3,711
Labor cost at 68 cents per hour	2,523.48	....
Annual total cost	3,789.48	....
Annual cost per hour	0.541	....

Twenty-third Year—161,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	848
161,000 hrs.	None	None
Increase annual maintenance, labor	....	346
Electrical:		
7,000 hrs.	353	535
161,000 hrs.	None	None
Increase annual maintenance, labor	....	264
Diesel engines:		
7,000 hrs.	310	1,272
161,000 hrs.	None	None
Increase annual maintenance, labor	....	462
Totals	1,126	3,727
Labor cost at 68 cents per hour	2,534.36	....
Annual total cost	3,660.36	....
Annual cost per hour	0.523	....

(Table continued top of next column)

Twenty-fourth Year—168,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	793
14,000 hrs.	20	17
21,000 hrs.	582	991
28,000 hrs.	20	20
42,000 hrs.	None	None
56,000 hrs.	None	None
84,000 hrs.	25	40
168,000 hrs.	None	None
Increase annual maintenance, labor	....	380
Electrical:		
7,000 hrs.	353	495
14,000 hrs.	None	None
21,000 hrs.	400	120
28,000 hrs.	650	50
42,000 hrs.	1,540	176
56,000 hrs.	None	None
84,000 hrs.	None	None
168,000 hrs.	None	None
Increase annual maintenance, labor	....	276
Diesel engines:		
7,000 hrs.	285	1,052
14,000 hrs.	120	....
21,000 hrs.	2,180	544
28,000 hrs.	550	40
42,000 hrs.	1,070	50
56,000 hrs.	None	None
84,000 hrs.	None	None
168,000 hrs.	None	None
Increase annual maintenance, labor	....	483
Totals	8,258	5,527
Labor cost at 68 cents per hour	3,758.36	....
Annual total cost	12,016.36	....
Annual cost per hour	1.717	....

Twenty-fifth Year—175,000 Hrs.

	Material cost	Labor hours
Mechanical:		
7,000 hrs.	$463	848
35,000 hrs.	Omit	Omit
175,000 hrs.	None	None
Increase annual maintenance, labor	....	396
Electrical:		
7,000 hrs.	353	535
35,000 hrs.	Omit	Omit
175,000 hrs.	None	None
Increase annual maintenance, labor	....	288
Diesel engines:		
7,000 hrs.	310	1,272
35,000 hrs.	Omit	Omit
175,000 hrs.	None	None
Increase annual maintenance, labor	....	504
Totals	1,126	3,843
Labor cost at 68 cents per hour	2,613.24	....
Annual total cost	3,739.24	....
Annual cost per hour	0.534	....

Table II — Estimated Material and Labor Costs for Maintaining Mechanical Equipment on the N. & B. 800-Hp. Diesel-Electric Locomotive*

Year	Hours at end of period	Material	Labor hours	Labor at 68 cents per hour	Total	Average cost per hour
1	7,000	$463	848	$576.64	$1,039.64	$0.149
2	14,000	483	882	599.76	1,082,76	0.155
3	21,000	1,045	1,817	1,235.56	2,280.56	0.326
4	28,000	503	935	635.80	1,138.80	0.163
5	35,000	718	1,164	791.52	1,509.52	0.216
6	42,000	1,065	1,883	1,280.44	2,345.44	0.335
7	49,000	463	947	643.96	1,106.96	0.158
8	56,000	503	1,001	680.68	1;183.68	0.169
9	63,000	1,645	2,175	1,479.00	3,124.00	0.446
10	70,000	798	1,318	896.24	1,694.24	0.242
11	77,000	463	1,013	688.84	1,151.84	0.165
12	84,000	1,110	2,043	1,389.24	2,499.24	0.357
13	91,000	463	1,046	711.28	1,174.28	0.168
14	98,000	483	1,079	733.72	1,216.72	0.174
15	105,000	1.300	2,265	1,540.20	2,840.20	0.406
16	112,000	503	1,133	770.44	1,273.44	0.182
17	119,000	463	1,112	756.16	1,219.16	0.174
18	126,000	1,665	2,340	1,591.20	3,256.20	0.465
19	133,000	463	1,145	778.60	1,241.60	0.177
20	140,000	818	1,504	1,022.72	1,840.72	0.263
21	147,000	1,045	2,114	1,437.52	2,482.52	0.355
22	154,000	483	1,211	823.48	1,306.48	0.187
23	161,000	463	1,194	811.92	1,274.92	0.182
24	168,000	1,110	2,241	1,523.88	2,633.88	0.376
25	175,000	463	1,244	845.92	1,308.92	0.187
		18,981	35,654	24,244.72	43,225.72	0.247

* Based on a 7,000-hr. year.

of determining Diesel-electric repair costs was not used.

All available traction repair costs given by the A. A. R. and the American Institute of Electrical Engineers, as well as the data on stationary power plants given by the American Society of Mechanical Engineers, were then reviewed in connection with the establishment of the Diesel costs. However, before this repair study was completed, the Northampton & Bath acquired an 800-hp., 116-ton double-power-plant Diesel-electric locomotive and operated it through the first mechanical overhaul period. This locomotive is equipped with two 9-in. by 12-in., four-cycle, 400-hp. engines which operate at 900 r.p.m. In order to obtain a comprehensive picture of completely Dieselized operation, a 400-hp. single-power-plant unit with similar Diesel equipment was leased by the road. The Diesel engine and electric equipment of this unit was later overhauled by the company

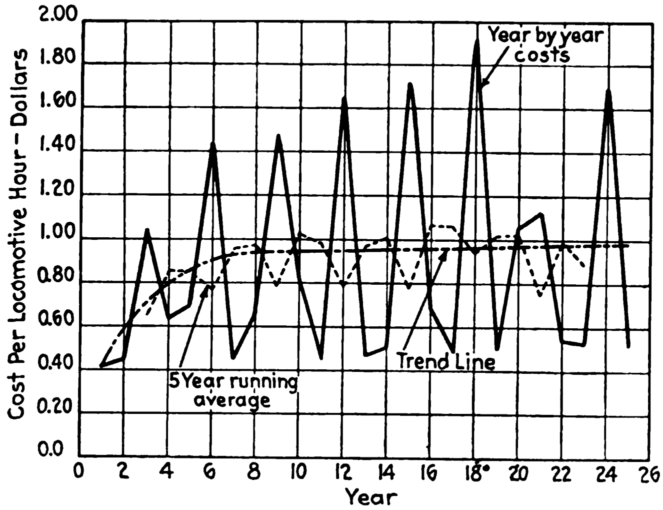


Fig. 4—Average repair cost for the entire locomotive

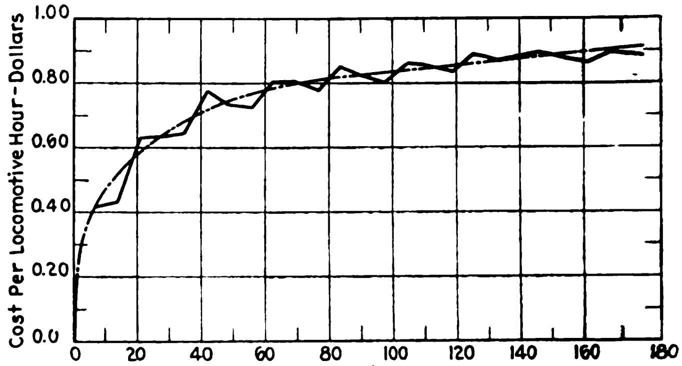


Fig. 5—Cumulative repair cost per locomotive hour for the 800-hp. N. & B. Diesel-electric locomotive

forces before being placed in service. Careful records of material, labor, maintenance, and other expense items were kept for both units throughout their entire operating period. Wear of parts (and thus their service life) was recorded, and all other pertinent data were preserved.

Table III—Estimated Material and Labor Costs for Maintaining Electrical Equipment on the N. & B. 800-Hp. Diesel-Electric Locomotive*

Year	Hours at end of period	Material	Labor hours	Labor at 68 cents per hour	Total	Average cost per hour
1	7,000	$353	535	$363.80	$716.80	$0.102
2	14,000	353	547	371.96	724.96	0.104
3	21,000	773	839	570.52	1,343.52	0.192
4	28,000	1,003	621	422.28	1,425.28	0.204
5	35,000	353	583	396.44	749.44	0.107
6	42,000	2,293	851	578.68	2,871.68	0.410
7	49,000	353	607	412.76	765.76	0.109
8	56,000	1,003	669	454.92	1,457.92	0.208
9	63,000	873	931	633.08	1,506.08	0.215
10	70,000	728	643	437.24	1,165.24	0.166
11	77,000	353	655	445.40	798.40	0.114
12	84,000	2,943	973	661.64	3,604.64	0.515
13	91,000	353	679	461.72	814.72	0.116
14	98,000	353	691	469.88	822.88	0.118
15	105,000	773	983	668.44	1,441.44	0.206
16	112,000	1,003	765	520.20	1,523.20	0.218
17	119,000	353	727	494.36	847.36	0.121
18	126,000	2,393	1,015	690.20	3,083.20	0.440
19	133,000	353	751	510.68	863.68	0.123
20	140,000	1,378	813	552.84	1,930.84	0.276
21	147,000	773	1,055	717.40	1,490.40	0.213
22	154,000	353	787	535.16	888.16	0.127
23	161,000	353	799	543.32	896.32	0.128
24	168,000	2,943	1,117	759.56	3,702.56	0.529
25	175,000	353	823	559.64	912.64	0.130
		23,115	19,459	13,232.12	36,347.12	0.208

* Based on a 7,000-hr. year.

Table IV—Estimated Material and Labor Costs for Maintaining Diesel-Engine Equipment on the N. & B. 800-Hp. Locomotive*

Year	Hours at end of period	Material	Labor hours	Labor at 68 cents per hour	Total	Average cost per hour
1	7,000	$310	1,272	$864.96	$1,174.96	$0.168
2	14,000	430	1,293	879.24	1,309.24	0.187
3	21,000	2,465	1,638	1,113.84	3,678.84	0.511
4	28,000	980	1,375	935.00	1,915.00	0.274
5	35,000	1,572	1,536	1,044.48	2,616.48	0.374
6	42,000	3,655	1,751	1,190.68	4,845.68	0.692
7	49,000	360	1,398	950.64	1,310.64	0.187
8	56,000	980	1,459	992.12	1,972.12	0.282
9	63,000	4,475	1,850	1,258.00	5,733.00	0.819
10	70,000	1,806	1,651	1,122.68	2,928.68	0.418
11	77,000	310	1,482	1,007.76	1,317.76	0.188
12	84,000	4,205	1,917	1,303.56	5,508.56	0.787
13	91,000	310	1,524	1,036.32	1,346.32	0.192
14	98,000	480	1,545	1,050.60	1,530.60	0.219
15	105,000	6,427	2,070	1,407.60	7,834.60	1.119
16	112,000	980	1,627	1,106.36	2,086.36	0.298
17	119,000	310	1,608	1,093.44	1,403.44	0.200
18	126,000	5,665	2,089	1,420.52	7,085.52	1.012
19	133,000	310	1,650	1,122.00	1,432.00	0.205
20	140,000	2,356	1,901	1,292.68	3,648.68	0.521
21	147,000	2,515	2,016	1,370.88	3,885.88	0.555
22	154,000	430	1,713	1,164.84	1,594.84	0.228
23	161,000	310	1,734	1,179.12	1,489.12	0.213
24	168,000	4,205	2,169	1,474.92	5,679.92	0.811
25	175,000	310	1,776	1,207.68	1,517.68	0.217
		46,156	42,044	28,589.92	74,745.92	0.427

* Based on a 7,000-hr. year.

Table V—Summary of Estimated Material and Labor Costs for Maintenance of Mechanical, Electrical, and Diesel-Engine Equipment on the N. & B. 800-Hp. Locomotive*

							Cumulative cost	
Year	Hours at end of period	Material	Labor hours	Labor at 68 cents per hour	Total	Average cost per hour	Total	Average per hour
1	7,000	$1,126	2,655	$1,805.40	$2,231.40	$0.419	$2,931.40	$0.41
2	14,000	1,266	2,722	1,850.96	3,116.96	0.445	6,048.36	0.43
3	21,000	4,283	4,294	2,919.92	7,202.92	1.029	13,251.28	0.63
4	28,000	2,486	2,931	1,993.08	4,479.08	0.640	17,730.36	0.63
5	35,000	2,643	3,283	2,232.44	4,875.44	0.696	22,605.80	0.64
6	42,000	7,013	4,485	3,049.80	10,062.80	1.438	32,668.60	0.77
7	49,000	1,176	2,952	2,007.36	3,183.36	0.455	35,851.96	0.73
8	56,000	2,486	3,129	2,127.72	4,613.72	0.659	40,465.68	0.72
9	63,000	6,993	4,956	3,370.08	10,363.08	1.480	50,828.76	0.80
10	70,000	3,332	3,612	2,456.16	5,788.16	0.827	56,616.92	0.80
11	77,000	1,126	3,150	2,142.00	3,268.00	0.487	59,884.92	0.77
12	84,000	8,258	4,933	3,354.44	11,612.44	1.659	71,497.36	0.85
13	91,000	1,126	3,249	2,209.32	3,335.32	0.476	74,852.68	0.82
14	98,000	1,316	3,315	2,254.20	3,570.20	0.510	78,402.88	0.80
15	105,000	8,500	5,318	3,616.24	12,116.24	1.731	90,519.12	0.86
16	112,000	2,486	3,525	2,397.00	4,883.00	0.698	95,402.12	0.85
17	119,000	1,126	3,447	2,343.96	3,469.96	0.496	98,872.08	0.83
18	126,000	9,723	5,444	3,701.92	13,424.92	1.918	112,297.00	0.89
19	133,000	1,126	3,546	2,411.28	3,537.28	0.505	115,834.28	0.87
20	140,000	4,552	4,218	2,868.24	7,420.24	1.060	123,254.52	0.88
21	147,000	4,333	5,185	3,525.80	7,858.80	1.123	131,113.32	0.89
22	154,000	1,266	3,711	2,523.48	3,789.48	0.541	134,902.80	0.87
23	161,000	1,126	3,727	2,534.36	3,660.36	0.523	138,563.16	0.86
24	168,000	8,258	5,527	3,758.36	12,016.36	1.717	150,579.62	0.89
25	175,000	1,126	3,843	2,613.24	3,739.24	0.534	154,318.76	0.88
		88,252	97,157	66,066.76	154,318.76	0.882		

* Based on a 7,000-hr. year.

The determination of repair cost trends was made by analyzing (1) the data collected by the Northampton & Bath on its two Diesel-electric units, (2) Diesel operating costs as furnished by other railroads, and (3) the cost of operating and maintaining steam locomotives. The analysis of these data resulted in a fairly accurate determination of the life of the various parts of the trucks, underframe, cabs, electrical equipment, Diesels and auxiliaries, as well as the labor hours required for replacing worn parts. The cost of maintaining the 800-hp. Diesel-electric locomotive over a twenty-five year period was then tabulated. These costs are given in Tables I to V, inclusive.

The data in Table I gives service hours expected from the various parts of the mechanical, electrical and Diesel equipment; the year in which the parts are expected to be replaced; and the labor hours required for replacing worn parts. In some cases it will be noted that hours of labor are omitted. In these instances the labor charge is taken care of either in dissembly and assembly of the individual units, or by the annual labor charge. It will be seen from Table I that it has been assumed the locomotive will have an average life of twenty-five years, and that it will give 7,000 hr. of service per year, which is equivalent to an availability of 80 per cent. The table also includes the total hours of labor, cost of labor at a rate of 68 cents per hour, and the total cost of labor and material for each year.

Tables II, III, and IV give summaries of the year-by-year cost for maintaining the mechanical, electrical, and Diesel equipment, respectively. These tables also show the total cost per year and the yearly average cost per hour for maintaining the locomotive. Table V is a grand summary which shows the average repair cost per hour for the entire locomotive as well as the total cumulative cost and average cumulative cost per year.

Figs. 1 to 5, inclusive, show the annual cost per locomotive hour of maintaining the mechanical, electrical, and Diesel equipment, the annual cost per locomotive hour of maintaining the entire locomotive, and the yearly accumulative repair costs. Trend lines and five-year running averages are also shown in these figures. Fig. 1 is plotted from Table II, Fig. 2 is plotted from Table III, and Fig. 3 is plotted from Table IV, showing the average repair costs per locomotive hour over the twenty-five year period for electrical, mechanical and Diesel equipment, respectively. Fig. 4, plotted from the values given in the seventh column of Table V, shows the average repair costs per locomotive hour for the entire locomotive over the twenty-five year period. Fig. 5, showing cumulative repair costs for this period, is plotted from values in the last column of Table V.

A.A.R. Passenger-Car

Air-Conditioning Report

On December 20, 1935, the Board of Directors of the Association of American Railroads authorized the Division of Equipment Research to undertake an extensive investigation of the air-conditioning of railroad passenger cars. The investigation was undertaken because of the magnitude of the investment in railroad air-conditioned equipment and the necessity of securing maximum returns from equipment installed now or to be installed in the future. Table I shows the extent of the investment in air-conditioned cars and terminal facilities owned by the railroads in the United States and Canada as of March 1, 1935. On October 1, 1936, there were 8,031 air-conditioned passenger cars in the United States and Canada, of which 3,907 were owned by the railroads and 4,124 were owned by the Pullman-Standard Car Manufacturing Company.

To accomplish the objectives of the investigation, the project was conceived as consisting of the following steps: (1) Survey of the performance of equipment in service; (2) determination of the efficiency of air-conditioning systems; (3) determination of the mechanical efficiency of the drive mechanisms; (4) study of the air requirements, treatment, diffusion, and related matters; (5) determination of the cost of air-conditioning per 1,000 car-miles; and (6) study of the factors relating to passenger comfort. During the course of the investigation, road tests were conducted on 594 passenger cars of which 434 were air-conditioned cars owned by railroads, 10 were railroad-owned cars not air-conditioned, and 120 were air-conditioned cars owned by the Pullman Company. The report submitted on this work is called a "Summary Report on Air-Conditioning of Railroad Cars," and deals entirely with the railroad-owned cars. A report on the Pullman cars is to be released at a later date. In addition to the summary report and the report on the Pullman cars, the A.A.R. will later release an engineering report to meet the needs of air-conditioning engineers and operating personnel, and reports to the individual railroads which assisted in conducting the investigation. These latter reports will give in detail the results obtained by testing the equipment of the respective railroads. The scope of the work done in securing the information for preparing these reports is presented in Table II.

Systems Tested and Results

It is seen from Table II that 15 air-conditioning systems were tested in the laboratory of which 12 were mechanical-compression units. The remaining three were steam-ejector, ice-activated, and evaporative-cooling units. During the tests of these units the inlet air to the cooling coil (the evaporator of the mechanical-compression systems) was maintained at 80 deg. F., and the relative humidity was maintained at 50 per cent

Table I—Net Charge to Investment Account—Air Conditioning Equipment—2,653 Cars Owned by 45 Railroads in U. S. and Canada, as of March 1, 1936

	Number of units	Total amount
Mechanical compression:		
Electro-mechanical drive	702	$3,922,245.46
Direct-mechanical drive (Pullman)	423	3,481,597.66
Internal combustion engine drive (Waukesha)	1	3,729.76
Head-end power drive (articulated trains)	20	66,275.58
Total	1,146	$7,473,848.46
Steam ejector	464	3,396,297.02
Ice activated	1,043	3,216,888.41
Total	2,653	$14,087,033.89
Additional facilities (terminal)	....	1,157,131.54 (a)
Grand Total	2,653	$15,244,165.43

(a) Values for two railroads not reported.

Table II—Scope of the A.A.R. Air-Conditioning Investigation

Number of air-conditioning systems tested in laboratory...		15
Mechanical compression	12	
Steam ejector	1	
Ice activated	1	
Evaporative cooling	1	
Number of drive mechanisms tested in laboratory		6
Belt	1	
Gear	2	
Belt and gear	2	
Friction	1	
Number of air-conditioned cars tested in hot room		14
Mechanical compression	7	
Steam ejector	1	
Ice activated	6	
Number of railroads that conducted road tests		31
Number of passenger cars on which road tests were conducted		594
Railroad-owned air-conditioned cars	434	
Railroad-owned non-air-conditioned cars	40	
Pullman air-conditioned sleepers	120	
Percentage of railroad-owned air-conditioned cars tested to total number of railroad-owned air-conditioned cars as of March 1, 1936		18
Approximate number of hours of road testing		5,200
Approximate number of miles of road testing		240,000
Number of passengers who submitted comments on conditions in air-conditioned cars while tests were being made		5,453
Approximate number of data readings recorded for all laboratory and road tests		250,000
Approximate number of calculations made from recorded data		85,000
The analysis of costs is based upon an experience record of 1,608 cars for 1935 with a total car mileage of....		178,259,768

in order to subject each of the systems to uniform test conditions.

Mechanical-Compression Systems—The performance of nine of the 12 mechanical-compression systems is shown in Table III. At a condenser air-temperature of 90 deg. F. all but two of the mechanical-compression systems tested delivered their rated capacity. The Frigidaire failed to produce its rated tonnage by 0.39 ton, and the Waukesha, in the three installations tested, failed by amounts up to 2.28 tons. The steam-ejector, ice-activated, and evaporative-cooling systems were not included in Table III because their power requirements are of a different character and order. On the basis of power consumption these systems cannot be compared directly with the mechanical-compression systems. The only way in which such a comparison may be made is on a cost basis; this will be discussed later.

Steam-Ejector System—The steam system requires both electrical power and steam, therefore, the power consumed is expressed in kilowatts and in pounds of steam per hour. The range for the one steam system tested was 0.58 to 0.64 kw. per ton, and 30.5 to 34.6 lb. of steam per hr. per ton of refrigeration, exclusive of the amount of condensate which ordinarily occurs in a train line. The electrical power required was approximately one third of that required by the most efficient mechanical systems. Throughout the entire range of condenser air temperatures at the zero resistance pressure, the capacity of the steam-ejector system tested remained constant, and its rated capacity at the refrigeration unit was obtained. The system tested consisted of a Carrier steam ejector, Safety pumps and motors, a Carrier condenser, and Aerofin cooling coils (Carrier-Safety design). Its weight was 3,698 lb.

Ice-Activated System—The ice-activated system tested consumed 0.17 to 0.21 kw. of electric power per ton of refrigeration and 76.7 to 78.3 lb. of ice per hr. per ton of refrigeration. The system delivered its rated capacity at a cold-water temperature of 41 deg. F. The system tested consisted of an American Car & Foundry bunker and cooling coils, a Worthington pump, and a Master motor. Its weight was 3,845 lb. with the bunker empty.

Evaporative-Cooling System—The Fleischer evaporative cooling system produces no refrigeration. The system has limited possibilities with respect to cooling railroad passenger cars. This system will produce comfort conditions only in those sections of the country where low wet-bulb temperatures prevail, or where only a slight temperature reduction is required. When used as a supplement to a refrigerating system it operates only as an air washer. The Fleischer system consumes 1.22 kw. of electric power. The system tested consisted of an Air & Refrigeration Corporation evaporative cooler, a Worthington pump, a Master motor, and a Clarage circulating fan. Its weight was 612 lb.

Table III—Power Requirements of 12 Mechanical Compression Air-Conditioning Systems Determined by Laboratory Tests

System	Description					Kilowatts per ton of refrigeration at air resistance pressures in inches of water		Wt. in lb.
	Compressor	Condenser	Evaporator	Compressor Motor	Expansion valve	in. of water Zero	kw. 0.35	
1. Airtemp-York (5-ton)..	York	York	York	Westinghouse	Detroit Lubricator	1.35	1.43	2,795
2. Carrier-Safety	Safety	Aerofin (a)	Aerofin (a)	Safety	Detroit Lubricator	1.48	1.57	3,030
3. Trane	Lipman	Trane evaporative	Trane	Wagner	Alco Constant Pressure	1.44	1.49	3,660
4. Airtemp-York (6-ton)..	York	York-evaporative (b)	York	Westinghouse	Detroit Lubricator	1.59	1.65	2,795
5. Airtemp-York (7-ton)..	York	York evaporative	York	Westinghouse	Detroit Lubricator	1.62	1.66	2,795
6. B&O-York	York	York evaporative	York	Fairbanks-Morse	Detroit Lubricator	1.70	1.75	2,396
7. General Electric	General Electric	Trane (c)	Trane (c)	General Electric	Detroit Lubricator	1.83	1.90	3,081
8. Frigidaire	Frigidaire	Frigidaire	Frigidaire	General Electric	Frigidaire	1.96	2.03	2,375
9. Waukesha-Sturtevant supercondenser	Ingersoll-Rand	Trane with Super-condenser	Sturtevant	Waukesha internal-Combustion engine	Alco Thermostatic			4,050
10. Baldwin-Southwark ..	De La Vergne			Century		2.48	2.78	3,134 (Two units)
11. Waukesha-Sturtevant..	Ingersoll-Rand	Trane	Sturtevant	Waukesha internal-combustion engine	Alco Thermostatic			3,450
12. Waukesha-Trane	Ingersoll-Rand	Trane	Trane	Waukesha Internal-combustion engine	Detroit Lubricator			3,420

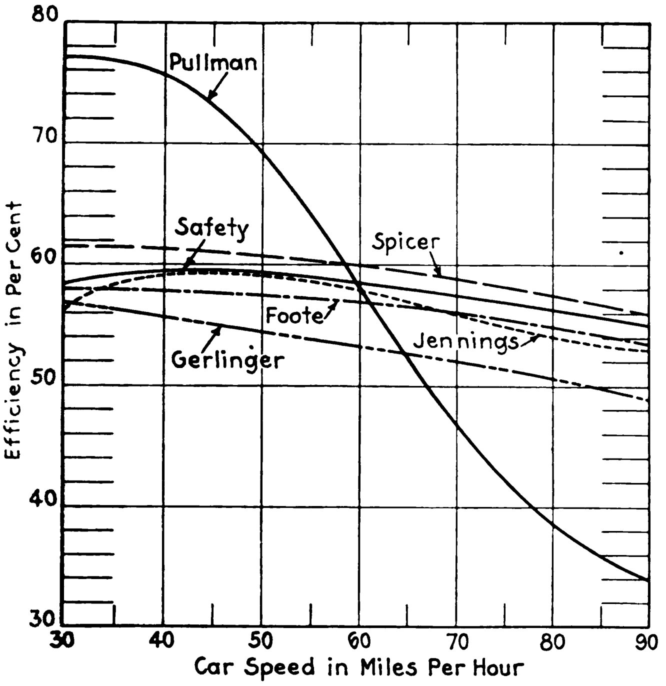
(a) Carrier-Safety design.
(b) Above 100 deg. Fahrenheit.
(c) General Electric design.

Drive Mechanisms

The mechanical efficiency of six types of drive mechanisms through which power is transmitted from the car axle to the cooling equipment was determined during the tests. The mechanical efficiency of the drives tested (including drive, generator, and compressor motor) were obtained, as shown in one of the figures, for equivalent car speeds between 30 and 90 m.p.h.

The drives tested were (1) the Spicer Railway Car hypoid gear drive for a 20-kw. generator; (2) a Foote Brothers spur-and-bevel gear for a 10-kw. generator; (3) Safety Car Heating & Lighting Company V-belt and bevel gear for a 20-kw. generator; (4) a Pullman drive, including speed control for operating the air-conditioning compressor; (5) a Jennings V-belt drive for a 10-kw. generator; and (6) a Gerlinger friction drive for a 5-kw. generator. Loads used during the tests ranged from zero to 36 hp. for the 20-kw. drives, from zero to 18 hp. for the 10-kw. drives, and from zero to 10-hp. for the 5-kw. drive. The Pullman direct drive was tested at constant torques of 51 and 71 ft.-lb., with a speed-control setting of 42 m.p.h. The torque of 71 ft.-lb. is that required to operate an air-conditioning system at full capacity.

In view of the trend toward higher train speeds, the comparison of the efficiency of the Pullman drive with the efficiencies of the other drives is significant. The Pullman drive is normally adjusted so that slippage in the speed control starts at a train speed of about 42 m.p.h. Below that speed, the compressor is operated at reduced speed and, consequently, at reduced capacity. Adjustment of the speed control, together with changes in the gear ratio, will make it possible to increase the speed at which slippage starts. In some cases the speed-control setting has been advanced from 42 to 55 m.p.h. for high-speed trains in order to improve the efficiency in the upper range of speeds. This means some sacrifice in the cooling capacity at speeds below 55 m.p.h. Some railroads use a heavy oil and a high level of oil with the Pullman



Efficiencies of car-axle drives, including generator and compressor motor for electro-mechanical drives and speed control (Set for 42 m.p.h. for Pullman direct drive)

drive. A lighter oil and a lower oil level would increase the mechanical efficiency somewhat.

The Gerlinger drive may be disregarded for air-conditioning purposes where mechanical-compression systems are used, because of insufficient capacity.

With belt drives the cost due to the loss of belts may be appreciable. This cost on one railroad, with fifty-nine cars and over a period of 32 months, was approximately $6,000. Belt losses and breakages are due to many causes, among which are flying ballast and the accumulation of snow and ice on the pulleys. One railroad increased belt life from 29,000 to 44,000 miles by increasing the diameter of the armature pulley from 8 in. to 10 in., and using a 5-in. six-ply rubber belt. A gear-drive mileage of 350,000 has been reported with evidence of only ordinary wear. The outstanding record reported was for a combination belt-and-gear drive which has been in service five years without failure. The mileage to September 1, 1936, was 1,000,000.

Table IV—Total Cost Per 1,000 Car-Miles for Four Types of Air-Conditioning Systems for Railroad Passenger Cars for an Average Cooling Season of Five Months, an Average Train Speed of 50 M.P.H., and an Average Car Mileage of 150,000 Miles Per Year, Based on Experience of 16 Railroads in 1935

	Electro-mechanical	Direct-mechanical	Steam ejector	Ice activated
Gross Installation Cost				
(a) Charged to investment account (gross)	$6,110.00	$8,493.00	$8,242.00	$3,587.00
(b) Charged to operating expense account	374.00	22.00	233.00	395.00
Total	$6,484.00	$8,515.00	$8,475.00	$3,982.00
Annual Fixed Charges				
(a) Investment:				
Depreciation at 12.5 per cent	$763.75	$1,061.63	$1,030.25	$448.38
Interest at 6 per cent.	366.60	509.58	494.52	215.22
Taxes and Ins. at 1.5 per cent.	91.65	127.39	123.63	53.80
Total	$1,222.00	$1,698.60	$1,648.40	$717.40
(b) Operating expense: Allocated over life of equipment at 12½ per cent.	46.75	2.75	29.13	49.38
Total annual fixed charge	$1,268.75	$1,701.35	$1,677.53	$766.78
Total Cost per 1,000 Car-Miles				
(a) Fixed charges	$8.45	$11.35	$11.18	$5.11
(b) Operation cost	.99	.93	1.02	5.29
(c) Maintenance cost ...	3.33	2.33	2.15	.97
Total	$12.77	$14.61	$14.35	$11.37

Cost Per 1,000 Car Miles

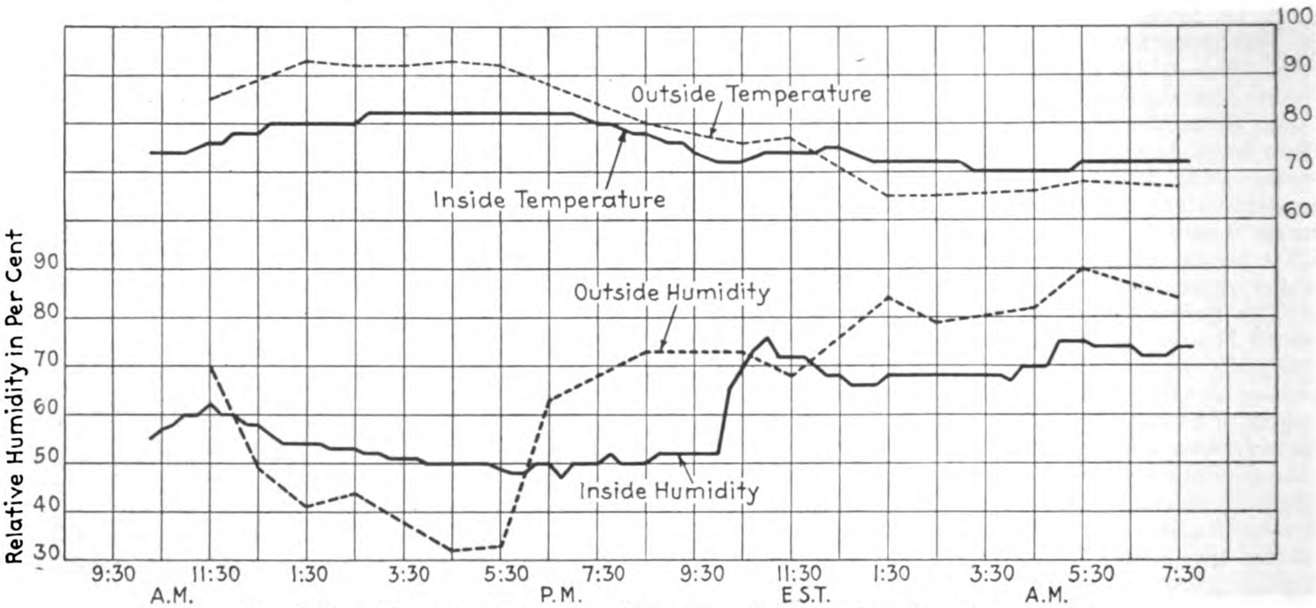
The total cost of installing four different types of air-conditioning systems is shown in Table IV, together with the cost per 1,000 car-miles. The figures shown in this table were derived from those submitted by 16 railroads, and are based on an average cooling season of five months, an average car mileage of 150,000 miles per year, and an average train speed of 50 m.p.h. The cost of maintenance, for 1935, was reported by the 16 railroads as shown in Table V.

Table V—Maintenance Cost of Air Conditioning—16 Railroads in 1935

	Number of units	Number of car-miles	Maintenance cost: Amount	Maintenance cost: Cost per 1,000 car-miles
Electro-mechanical	391	35,557,629	$118,538.22	$3.33
Direct-mechanical (Pullman)..	312	42,926,532	100,043.03	2.33
Steam ejector	223	28,434,558	61,026.23	2.15
Ice activated	527	48,771,407	47,139.34	.97

Comparative total costs per 1,000 car-miles of four different methods of air-conditioning railroad passenger cars for cooling seasons of three and ten months, for train speeds of 30, 50, 70, and 90 m.p.h., and for car mileages ranging from 50,000 to 250,000 are shown in Table VI. The influence of car mileage, train speed, and length of cooling season upon the cost per 1,000 car-miles for each of the four air-conditioning systems can be readily observed from this table.

From an analysis of such figures as given in Table VI it is evident that the economics of air-conditioning, from an operating standpoint, is affected by a number of factors, namely, (a) the length of the cooling period and



Undesirable inside temperatures and humidities observed during a test of an air-conditioned car

the atmospheric conditions prevailing during that period, (b) the average speed in miles per hour, and (c) the total number of car-miles per year. Because of this, a categorical statement cannot be made as to which system is the best from the standpoint of economics. In each case, the selection has to be made on the basis of the prevailing operating circumstances to be confronted. Table VI has been prepared so that the total cost per 1,000 car-miles may be determined in accordance with the character of the variables to be confronted. There is presented in Table VII a number of examples to illustrate the use of Table VI. The costs shown in Table VII are based on the average speed in miles per hour and the car-miles per year which approximate the average scheduled speeds and car-miles of typical trains in the several regions. The several regions are listed in accordance with approximate present practice with respect to the length of the cooling season. There is, of course, no sharp boundary line concerning these matters.

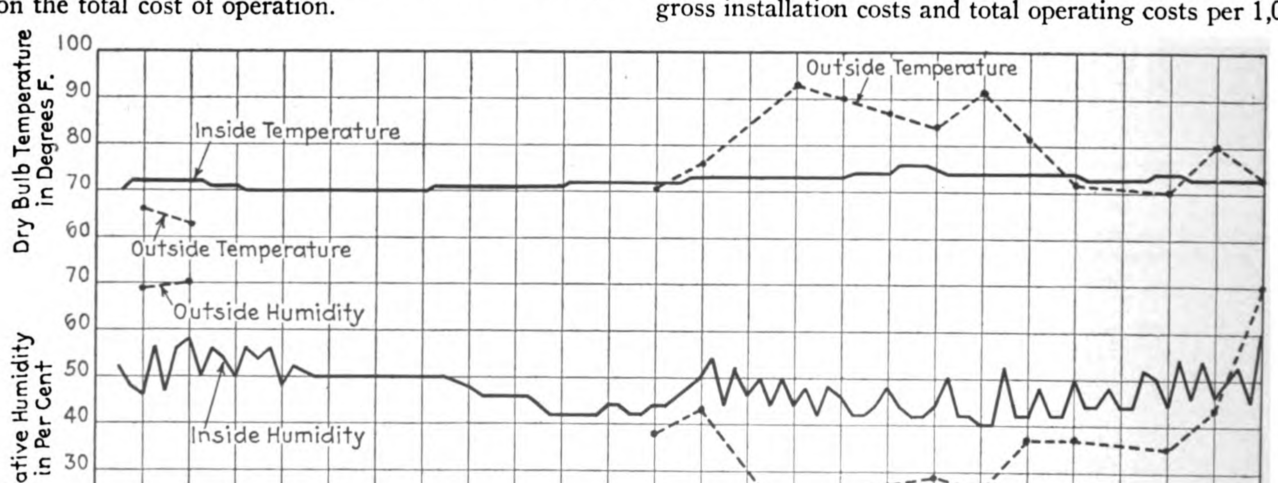
Economics of Air Conditioning

The foregoing cost figures bring forward the influence of the cost of installation, and therefore, of fixed charges upon the total cost of operation.

The fixed charges for an ice system are the lowest of all systems. During cooling seasons of three and five months, the fixed charges of the ice system influence the total cost more than does the cost of operation; hence, the total cost for the ice system is the lowest. However, with a cooling season of eight or ten months, the cost of operation of the ice system influences the total cost more than do fixed charges. This being the case, the ice system becomes more expensive than the electro-mechanical system. The fixed charges for the electro-mechanical system are less than all other systems, except ice. For this reason, the total cost of operation of the electro-mechanical system for cooling seasons of eight and ten months is the lowest of all the systems.

The foregoing discussion of the ice and electro-mechanical systems focuses attention upon the importance of the gross cost of installation. It is the gross cost of installation which must be reduced if a material reduction in the total cost per 1,000 car-miles is to be accomplished.

It is recognized that in selecting an air-conditioning system there are other factors than cost which must be considered. These are reliability, adequacy of results obtained, terminal facilities, and other matters. However, gross installation costs and total operating costs per 1,000



Desirable inside temperatures and humidities during a 25-hr. run of an air-conditioned car

Table VI—Comparative Total Cost Per 1,000 Car-Miles of Four Different Methods of Air Conditioning Railroad Passenger Cars for Cooling Seasons of Three and Ten Months

	Cost per 1,00 car-miles on the basis of the following car-miles per year:				
	50,000	100,000	150,000	200,000	250,000
Train speed of 30 m.p.h.:					
Electro-mechanical:					
Three months	$29.89	$17.20	$12.96	$10.85	$9.58
Ten months	30.73	18.04	13.80	11.69	10.42
Direct-mechanical:					
Three months	37.47	20.46	14.80	11.95	10.25
Ten months	38.09	21.08	15.42	12.57	10.87
Steam ejector:					
Three months	36.95	20.18	14.58	11.79	10.10
Ten months	37.57	20.80	15.20	12.41	10.72
Ice activated:					
Three months	21.74	14.08	11.52	10.25	9.49
Ten months	32.81	25.15	22.59	21.32	20.55
Train speed of 50 m.p.h.:					
Electro-mechanical:					
Three months	29.56	16.87	12.63	10.52	9.25
Ten months	30.07	17.28	13.14	11.03	9.76
Direct-mechanical:					
Three months	37.16	20.15	14.49	11.64	9.94
Ten months	37.58	20.57	14.91	12.06	10.36
Steam ejectors:					
Three months	36.62	19.58	14.25	11.46	9.77
Ten months	36.99	20.22	14.62	11.83	10.14
Ice activated:					
Three months	19.70	12.04	9.48	8.21	7.44
Ten months	27.17	19.51	16.95	15.68	14.91
Train speed of 70 m.p.h.:					
Electro-mechanical:					
Three months	29.50	16.81	12.57	10.46	9.19
Ten months	29.88	17.19	12.95	10.84	9.57
Direct-mechanical:					
Three months	37.17	20.16	14.50	11.65	9.95
Ten months	37.64	20.63	14.97	12.12	10.42
Steam ejector:					
Three months	36.57	19.80	14.20	11.41	9.72
Ten months	36.84	20.07	14.47	11.68	9.99
Ice activated:					
Three months	18.88	11.22	8.66	7.39	6.62
Ten months	23.62	15.96	13.40	12.13	11.36
Train speed of 90 m.p.h.:					
Electro-mechanical:					
Three months	29.63	16.94	12.70	10.59	9.32
Ten months	29.94	17.25	13.01	10.90	9.63
Direct-mechanical:					
Three months	37.31	20.30	14.64	11.79	10.09
Ten months	37.83	20.82	15.16	12.31	10.61
Steam ejector:					
Three months	36.73	19.96	14.36	11.57	9.88
Ten months	36.94	20.17	14.57	11.78	10.09
Ice activated:					
Three months	18.57	10.91	8.35	7.08	6.31
Ten months	22.26	14.60	12.04	10.77	10.00

EDITOR'S NOTE: This table is a composite of two tables found in the A.A.R. summary report. It has been compiled to show the spread in cost per 1,000 car-miles of the four air-conditioning systems between seasons of three and ten months duration. The A.A.R. summary report also contained tables showing the cost per 1,000 car miles for seasons of five and eight months.

car-miles are dependable units of measurement and, hence, due weight should be accorded them. This is especially true in the light of the large potential investment confronting the railroads through an increase in the number of cars to be air conditioned. In considering the economics of air conditioning, it must be remembered that the overall cost, efficiency, and economy of any air-conditioning system may be markedly affected by the cost, efficiency, and economy factors associated with each element of the system. For instance, a given air-conditioning system may be composed of a combination of parts such that the gross installation cost, efficiency, and economy of the system will be all that could be expected. If a substitution is made for some parts, which substituted parts do not rank equally with those replaced, it may be found that the overall cost, efficiency, and economy are much less favorable than they were in the first case. This means that in selecting and purchasing an air-conditioning system, the purchase price, efficiency, and economy of each part should be considered carefully. Otherwise, there may be no assurance of the merits and the reasonableness of the cost of the system selected and purchased.

Table VII—Average Cost Per 1,000 Car-Miles of Four Different Methods of Air Conditioning Passenger Cars for Cooling Seasons in Various Locations of the United States and Canada*

	Average Cost per 1,000 car-miles for seasons of the following lengths:			
	3 months [1]	5 months [2]	8 months [3]	10 months [4]
Electro-mechanical	$12.63	$12.77	$12.99	$13.44
Direct-mechanical	14.49	14.65	14.78	14.91
Steam ejector	14.25	14.35	14.51	14.62
Ice activated	9.48	11.37	14.22	16.95

* Values in this table are based on the average speed in miles per hour and the car-miles per year which approximate the averaged scheduled speeds and car-miles of typical trains in the several regions listed as follows:
[1] New England, Great Lakes, and Northwestern.
[2] Great Lakes, Central Eastern, Pocahontas, and Northwestern.
[3] Pocahontas, Southwestern, and Central Western.
[4] Southern, Southwestern, and Central Western.
These regions are listed in accordance with approximate present practice with respect to cooling seasons.
EDITOR'S NOTE: This table is not found in the A.A.R. summary report, but has been compiled from data in the report to facilitate presentation.

The Waukesha system was not included in the foregoing economic analysis because only one installation was made prior to 1936. An effort will be made to obtain the necessary information concerniug the 1936 installations upon which to base an analysis.

Factors Relating to Passenger Comforts

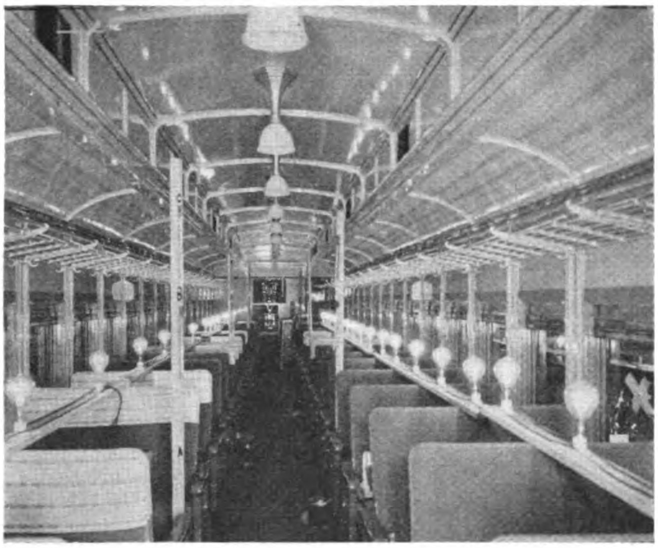
Variations in conditions in 302 air-conditioned cars were determined from data gathered by 20 railroads during regular service runs made from August 1 to September 15, 1936. It was found that a temperature between 72 and 76 deg. F. has been selected as most desirable to maintain relative humidity with the range of 30 to 60 per cent., and that a relative humidity of 70 per cent is undesirable. The prevailing thought appears to be that the desirable air movement within an air-conditioned car is 25 to 75 ft. per min., and that the maximum permissable is 120 ft. per min.

Table VIII—Analysis of the 4.4 Per Cent of Passenger Comments Which Were Unfavorable

	Number of comments	Percentage of total comments
Much too warm	75	2.7
Slightly too warm	505	17.9
Much too cool	51	1.8
Slightly too cool	530	18.7
Clammy	113	4.0
Stuffy	240	8.5
Drafty	197	7.0
Noisy	196	6.9
Too cool upon entering	205	7.3
Objectionable odor	140	5.0
Excessive tobacco smoke	135	4.8
Too much heat from sunshine through windows	435	15.4
Total number of unfavorable comments..	2,822	100.0

The average volume of fresh air in cubic feet per minute delivered into the cars through the cooling system during the tests was determined for each of 114 runs. The average for the runs varied as follows: Less than 200 cu. ft. per min. for 10 runs; from 200 to 399 cu. ft. per min. for 43 runs, from 400 to 599 cu. ft. per min. for 41 runs; from 600 to 799 cu. ft. per min. for 16 runs; and 800 cu. ft. per min. and over for 4 runs. Typical conditions of inside temperature, outside temperature, and humidity in air-conditioned cars are shown in two of the figures.

Temperature and Humidity Control—The process of



Car equipped with instruments for test of air-conditioning system. Light bulbs are used to deliver sensible heat. Insulated water pots in the aisles are used to deliver latent heat. Thermometers are located at duct outlets at the car roof. Thermocouples are used to obtain surface temperature of the car. Panel board is shown in the background

cooling cars, like that of heating, requires some form of temperature control. The optimum comfort in air-conditioned cars will not be attained until the control problem is solved. The solution of the problem will also contribute to a reduction in operating costs. There are three general types of controls: Manual, semiautomatic, and automatic. The latter two are accomplished by various means. These will be discussed at length in the engineering report (this will be submitted at some later date by the A.A.R). The manual type of control is highly unsatisfactory. If uniform and regular performance is desired, it should not be used. The semiautomatic type is a marked improvement over the full manual, but the human element is associated with it. The elimination of this element is desirable. The automatic types have not been perfected to the degree desired. There is much development work necessary. There are those who feel that a form of modulated temperature control is needed. Such a type of control would automatically maintain within the car a predetermined number of degrees lower temperature than the outside temperature. A successful control of this type would mark a real advance in air conditioning. Temperature control is inseparably associated with humidity control. There is a diversity of opinion as to the need for humidity control. Most authorities agree that some type of humidity control is advisable.

Filters—An important advantage of air conditioning passenger cars is cleanliness. The cleaning is done by passing air through the filters, which are not only important from the viewpoint of cleanliness, but also with respect to odors. The filter problem is indicated by the many different types being used. They are either dry or impregnated with oil of varying viscosity, and are made of spun bronze wool, not coated; series of wire screens of progressive decrease in mesh, oil coated; metal shavings packed in a frame; spun glass; copper sprayed with oil impregnated hair; oiled paper; perforated cardboard coated with oil; and others. They range in price from 65 cents to $17.00 each. The filter is too important an element with respect to cleanliness, odors, and operation costs to be neglected. There is a real need for a thorough and exhaustive study of the entire filter situation.

Odors—The problem of odors is universal. Some railroads have had reasonable success in reducing them. Odors result mainly from gas or smoke from the locomotive, tobacco smoke, body odors given off by passengers, improperly maintained toilets, refuse thrown on the floor by passengers and from cooking and garbage in the dining cars. Odors are aggravated by humidity in excess of 60 per cent within the car and by an excessive use of disinfectant. Tobacco smoke, dust, and moisture produce a sour smell in the cooling coils if they are not cleaned often enough. Filters become impregnated with nicotine and grease, and odors result if they are not frequently cleaned or renewed. From the use of oil on the filters, a gummy substance settles in the ducts which absorbs odors from cosmetics, tobacco, garbage, and other material. Deodorants have been used with varying success. The use of ozone has been widely discussed as a purifying agent. Its value is doubtful.

Passenger Reactions and Comments

One phase of the road work was to ascertain the reactions of passengers to the conditions prevailing in the air-conditioned cars. At the time the road engineers were making observations in a car, each passenger was given a card. This card requested the passenger to cooperate in making the study by indicating thereon his reaction to a number of factors, such as temperature, odors, and the like. An analysis of these comments appears in Table VIII.

Dynamic Stresses in Freight-Car Design

(*Continued from page 101*)

alloy steel or other materials, he knows what further weight reductions can be made, taking into account higher permissible stresses and their corresponding deflections.

He knows how to iron out peak stresses and deflections and how to avoid or cushion the reversal of stresses. He knows how to avoid dynamic, as well as static, stress concentrations. He knows how to make the structure approach unitary action.

He appreciates the fallacy of considering all members of a built-up structure of equal value. The fewer the parts, if the design properly locates them, the lighter and better the structure, i.e., with the above qualifications, the closer we approach the unit structure the better off we are. You can't put a lot of members together by any known method and hope to get results corresponding to the sum total of these members, no matter what materials or methods of construction are used. As just one proof of this, the new A. A. R. center sill is an example of a unit member which has a cross-sectional area of approximately 21 sq. in. This sill, under the same testing conditions, gave a better account of itself and was subjected to higher impact speeds than the built-up riveted A. A. R. center sill, composed of three members having a cross-sectional area of 28 sq. in.

A freight car at rest is only of passing interest; the same may be said of static stresses and deflections; cars must be designed and built for service or dynamic stresses. Take two 50-ton cars, loaded to journal capacity, with one car moving at a rate of six to seven miles an hour and striking the other car at rest. What happens? The car structure must absorb or transmit impact forces for all speeds above this. Did it ever occur to you that a proper car structure might minimize damage to lading?

The reasons for putting so much emphasis on the

necessity of constructing cars to meet the dynamic forces must be evident. Light-weight freight cars are the goal which we are approaching. This means that every pound in a car or truck structure must be there because it is needed, and it must be where it is needed. In the end, using only the required amount and the proper placing of this material means lower first cost to the railroad and an increase in ratio of lading capacity to light or tare weight, with attendant reduction in operating cost, which is the economic urge.

High-Pressure Locomotive Safety Valves

Its FG-10 muffled and FC open pop locomotive safety valves, which were developed to meet the condition of increased evaporating efficiency on high pressure locomotive boilers, are reported by the Ashton Valve Company, Boston, Mass., to have operated successfully for a period of over five years in road tests on locomotives carrying pressures up to 300 lb. sq. in. The valves have operated throughout this period without the necessity of the renewal of any parts.

The general construction principles are the same as the regular Ashton locomotive safety valves, being provided with wide wing guides in the bottom section and a sleeve guide at the top to keep the wing guide in alignment. The springs are guaranteed for five years when used for the pressure for which they are constructed.

The valves, built on the bolted body principle, are provided with pop regulators for adjusting and regulating the pop. These regulators are always accessible, requiring no special wrenches, and function on the same principle as an ordinary globe valve. No rings or sleeves are required for regulating blowback.

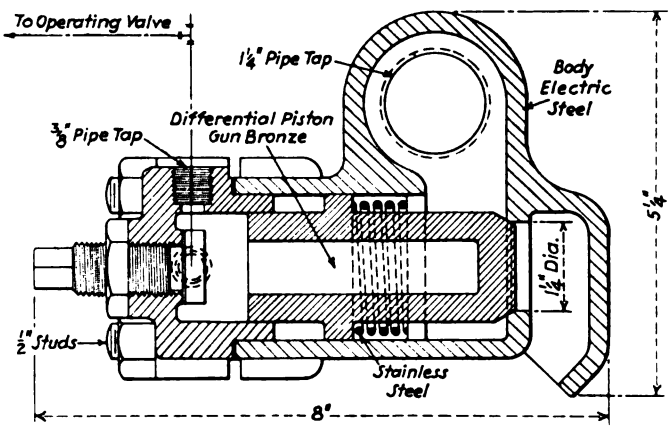
Steam-Operated Cylinder Cock

A steam-operated cylinder cock with a large opening from cylinder to atmosphere, equivalent to the capacity of 1¼-in. pipe, has been placed on the market by the T-Z Railway Equipment Company, Chicago. The use of steam instead of air as an operating medium is said to make the device more positive and reliable in action and eliminate the possibility of air defects.

The new cylinder cock is controlled both manually and automatically. Manual operation is obtained through a rotary cab-operating valve which, in closed position, admits steam at boiler pressure onto a differential piston which holds each cylinder cock closed against cylinder pressure. When the cab valve is moved to open position, boiler pressure is shut off from the cylinder cock steam chamber and the latter exhausted to the atmosphere, when the cylinder cock will instantly open by the action of cylinder pressure on the differential piston. The cylinder cock also automatically opens by pressure, due to compression, water, etc., above a pre-determined amount, thus eliminating possible damage to cylinder heads and reciprocating parts.

With the cab valve in open position and the main throttle closed, as in the enginehouse, the cylinder cock automatically opens by means of a stainless steel compression spring about the differential piston aided by a slight accumulation of cylinder pressure, thus preventing accidental movement of the locomotive.

The adjusting screw in the cap permits the cylinder cock to be clamped closed in the event of a broken steam pipe thereto, and for testing superheater units and cylinders. Freezing is prevented and cylinder lubrication improved when drifting by providing a slight circulation of live steam about the differential piston which steam passes into the cylinder instead of the atmosphere and therefore cannot impair clear forward vision.

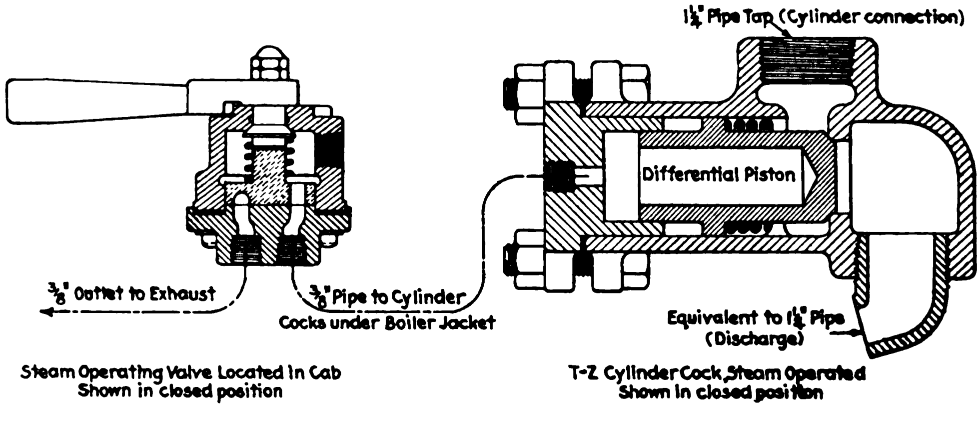


Section through the cylinder cock

This type of cylinder cock is suitable for right or left application by reversing the 1¼-in. pipe plug at the cylinder connection. This plug affords an additional advantage, since by its removal, dirt and carbon can be blown from the cylinder without disturbing the cylinder cocks or piping.

The design provides maximum clearance above the rail to reduce the liability of being knocked off by roadway obstruction. It is also applicable to cylinder exhaust channels and receiver pipes of Mallet locomotives.

Sectional views of the T-Z steam-operated cylinder cock and cab operating valve



Seven-Year Summary of Air-Conditioned Cars

Name of Railroad	Total Cars: Dec. 31, 1935	Total Cars: Dec. 31, 1936	Type of Car: Coaches	Comb.	Dining (Note 1)	Chair (Note 2)	Observ.	Sleeping (Note 3)	Business	Type of System: Electro-Mech.	Direct Mech.	Ice	Steam Ejector	Type of Refrigerant: Freon	Water	Ice	Other Refrigerants
Alton	25	25	4	4	9	6	2	...	...	25	...	...	...	24	...	...	1
A. T. & S. F.	136	187	26	...	49	94	18	...	...	1	...	...	186	...	186	...	1
A. C. L.	22	75	65	...	10	...	...	...	...	3	...	...	72	3	72	...	...
B. & O.	193	275	163	44	54	4	8	...	2	275	...	...	...	275	...	...	...
B. & M.	24	43	35	4	4	...	...	...	...	13	...	30	...	13	...	30	...
Can. Nat'l	...	56	...	...	3	27	...	26	...	...	...	56	...	...	...	56	...
Can. Pac.	...	141	8	4	5	6	4	114	...	2	7	131	1	9	1	131	...
Cen. of Ga.	4	13	11	...	2	...	...	...	...	...	...	...	13	...	13	...	...
C. R. R. of N. J.	13	18	13	2	3	...	...	...	...	18	...	...	...	18	...	...	...
C. & O.	37	52	31	4	12	...	...	...	5	...	52	...	...	52	...	...	...
C. & E. I.	10	20	11	2	7	...	...	...	...	...	...	5	15	...	15	5	...
C. & N. W. (Incl. C. St. P. M. & O.)	105	150	75	10	40	15	10	...	...	14	48	88	...	48	...	88	14
C. B. & Q. (Incl. Ft. W. & D. C.)	103	133	43	...	38	39	5	8	...	95	4	34	...	99	...	34	...
C. M. St. P. & P.	90	163	55	...	28	23	4	53	...	...	2	...	161	2	161	...	...
C. R. I. & P.	48	119	49	4	31	31	4	...	...	...	2	105	12	2	12	105	...
D. & H.	1	5	...	...	5	...	...	...	...	...	...	5	...	...	...	5	...
D. L. & W.	21	33	20	...	11	...	1	...	1	5	15	13	...	20	...	13	...
D. & R. G. W.	32	40	21	...	12	...	7	...	...	...	...	40	...	...	...	40	...
Erie	21	22	15	...	4	...	...	...	3	...	1	...	21	1	21	...	...
Fla. E. C.	11	32	26	...	6	...	...	...	...	...	...	...	32	...	32	...	...
Grt. Nor.	29	37	16	...	20	...	...	...	1	...	...	37	...	...	...	37	...
G. M. & N.	5	5	1	...	2	...	...	2	...	5	...	...	...	5	...	...	...
Ill. Cen.	55	120	59	10	35	10	2	...	4	11	96	13	...	107	...	13	...
Lehigh Valley	14	14	4	...	7	3	...	...	...	14	...	...	...	14	...	...	...
L. & N.	13	52	39	...	13	...	...	...	...	...	...	...	52	...	52	...	...
Me. Cen.	7	12	10	2	...	...	...	...	...	...	...	12	...	...	...	12	...
M. St. P. & S. Ste. M.	...	7	...	...	3	...	4	...	...	...	7	...	...	7	...	...	...
M.-K.-T.	17	17	...	...	9	3	4	...	1	6	...	3	8	3	8	3	3
Mo. Pac.	149	303	124	16	96	53	5	...	9	36	1	211	55	36	55	211	1
N. C. & St. L.	5	13	7	...	6	...	...	...	...	...	...	...	13	...	13	...	...
N. Y. Cen. System	146	208	106	1	98	2	1	...	...	135	58	15	...	193	...	15	...
N. Y. C. & St. L.	4	6	5	...	...	...	...	...	1	...	6	...	...	6	...	...	...
N. Y. N. H. & H.	213	332	279	17	30	2	4	...	...	199	...	133	...	199	...	133	...
Nor. & West.	41	91	62	15	11	...	...	...	3	84	...	3	4	84	4	3	...
Nor. Pac.	45	53	20	...	17	2	14	...	...	...	53	...	...	53	...	...	...
Pennsylvania	369	502	288	95	119	...	...	...	...	82	...	419	1	81	1	419	1
Pullman Co.	3,233	4,151	...	...	...	381	494	3,276	...	169	2,303	1,352	327	2,472	327	1,352	...
Reading	30	46	28	10	8	...	...	...	...	46	...	...	...	46	...	...	...
R. F. & P.	17	17	10	2	5	...	...	...	...	10	5	...	2	15	2	...	...
St. L.-S. F.	69	85	39	2	21	14	5	2	2	...	1	84	...	1	...	84	...
Seaboard A. L.	59	67	29	13	22	...	...	...	3	3	64	...	...	67	...	...	...
Southern	27	34	...	...	34	...	...	...	...	...	...	...	34	...	34	...	...
So. Pac.	138	257	99	...	70	60	28	...	...	...	23	226	8	23	8	226	...
Tex. & Pac.	51	57	39	...	9	4	3	...	2	1	6	21	29	7	29	21	...
Union Pac.	187	221	63	...	61	60	37	...	...	17	166	...	38	183	38	...	...
Wabash	40	94	30	...	33	29	...	...	2	1	...	93	...	1	...	93	...
Western Pac.	8	15	7	...	5	...	3	...	...	...	3	...	12	3	12	...	...
Total	5,867	8,418	2,035	261	1,067	868	667	3,481	39	1,270	2,923 [4]	3,129	1,096	4,172	1,096	3,129	21

Note 1—Includes lounge-diners, coach-diners, cafe-chair, cafe-coach, kitchen-coach and buffet cars.
Note 2—Includes lounge-chair, coach-chair and observation-chair cars.
Note 3—Includes lounge and observation-sleepers.
Note 4—Includes 66 cars on which the compressor is driven by a gas engine.

EDITORIALS

Mechanical Engineer Of Distinction

Sir John Aspinall, who died in England, January 19, at the age of 85, means little, if anything, to the present generation of railway mechanical executives in this country, and yet in Great Britain his ability and achievements in that department are highly regarded, despite the fact that he was promoted to the position of general manager of the Lancashire & Yorkshire as far back as 1899. He was chief mechanical engineer (head of the mechanical department) on that road from 1886 to 1899, assuming that office at the age of 35.

It was while in that position that he built the great shops at Horwich. The first new locomotive was completed in 1889 and in the ten years which followed, 667 locomotives of various types were built under his direction. These included his Atlantics, among the earliest of that type to be constructed.

As general manager of the road he made a splendid reputation as an administrator, but he never lost interest in engineering problems. It was under his direction that the electrification program was started, the completion of the electrification of the Liverpool & Southport in 1904 marking the first "main line" electrification in the United Kingdom.

Sir John retired from the general managership in 1919. He was knighted in 1917. Many years ago he was made an honorary member of the council of the British Institution of Mechanical Engineers—a signal and unusual honor—and in that capacity regularly attended all council meetings. He was recently awarded the first International James Watt Medal; unfortunately he died only a few days before the actual presentation was to be made.

He was indeed a grand old man and apparently was held in much the same high regard and affection among the engineers of England as is Ambrose Swasey among the engineers of this country.

That fine human understanding is not divorced from technical ability is indicated by the following rare tribute which was paid to him by The Engineer (London): "To give a list of his works would be merely tiresome, and now, when we are mourning his death we prefer to think of his qualities as a man, his rare and courtly charm, his ability in the selection of the right men for the right positions, the gentle skill with which he trained them, and the encouragement with which he guided them. . . . There are men of firm conviction who gain their way by force of character; there are others, and Aspinall was amongst them, who persuade others to be of the same mind as themselves. To them is given a greater inheritance in the hearts of their friends."

And there is great need for such executives in all departments of the railways and industries in these days, when employer and employee relationships are of so vital import.

What the Passenger Thinks

The effort which has been exercised in recent years to modernize passenger train equipment; the introduction of high-speed trains, including those of the streamlined type; and the rebuilding of old cars for use on crack trains, has thrown out into strong and positive relief the shortcomings and inadequacy of the older equipment. An article in a recent number of the Railway Age by Clarke A. Richards on "See Yourself as Your Passenger Sees You," has started a spirited discussion on the inadequacies of passenger service.

That the railroads are good sports and not averse to constructive criticism is indicated by the fact that they have ordered thousands of reprints of the article for distribution to their employees. Incidentally, many of the so-called "railway fans" have taken issue with some of Mr. Richards' comments, or have come to the support of the railways in an attempt to explain them. Even a railroad enthusiast, however, cannot explain away facts.

While courtesy and service come in for criticism, inadequacies in the equipment and facilities are not overlooked. Antiquated day coaches, poor illumination, filthy toilet facilities, bad ventilation, artistic but insufficient baggage racks, and dirty coaches are matters for which the mechanical department is wholly or partially responsible.

The facts are clear enough; indeed they are admitted on many roads. The problem is what to do about it. The railroads need business. Improvements thus far made, coupled with lower passenger rates and better business conditions, have demonstrated that more up-to-date equipment is appreciated. Living conditions have steadily improved in this country and the dirty, poorly lighted and uncomfortable equipment cheerfully tolerated not so many years ago, will not be put up with or, if it is necessary to use such trains, these conditions will be resented and the patrons will be critical and dissatisfied.

New equipment is being purchased, but it will take

a long time to retire all of the older cars. Wonders can be done, however, at a reasonable and justifiable cost, if there is the will to do it. Much depends on the ingenuity and resourcefulness of the mechanical department in finding ways and means of making the coaches more attractive and comfortable, and in keeping them clean and orderly.

Research Defined

During the depression the railroads were subjected to much criticism for their alleged failure to employ "scientific research" in the improvement of their physical plant. Owing to the dramatization of the more or less spectacular developments which have come from scientific and engineering research laboratories, the impression became strong in the popular mind that the railroads were unprogressive because they had no research laboratory in their front yard. Worse than this, a number of eminent scientists, some pedagogic and some industrial in their affiliations, followed the same uncritical thought process to the same illogical conclusion and, with evangelic zeal, took it upon themselves to convert the railroads to "science." They were dealt with very neatly by Coordinator Eastman.

The two greatest difficulties in the way of a clear understanding of the relationship between research and the railways have been the lack of a suitably qualified and generally accepted definition of the term "research" and the failure to distinguish the fundamental difference in approach to research by the railroads, who are not manufacturers, but purchasers, of their physical facilities, and other industries in which research has been extensively employed in the development of commodities which the industries produce for sale or for their own use. In a paper presented before the February meeting of the New England Railroad Club, L. W. Wallace, Director, Equipment Research Division, Association of American Railroads, has performed a useful service by clearing away both of these difficulties.

Mr. Wallace points out that "the railroad industry is a service industry. It is not a manufacturer. It is not a research agency. It is not a producer of the commodities it uses. Its relation to the commodities it buys and uses is that of a consumer—a purchaser." Continuing, Mr. Wallace says: "The fundamental background or foundation of all the things which the railroad uses is the sum total of the research, development work, engineering ability and experience of all of the producers of the 70,000 commodities which the industry uses, plus its own 100 years of research, development work, engineering and experience."

In defining research as it applies to the development of physical facilities, Mr. Wallace suggests three simple classifications a clear understanding of which should do much to eliminate fruitless discussion and misunderstanding of the relationship of the railroads to research. He proposes the term "fundamental research" to take in those research activities, the objective of which is to discover the basic principles underlying the universe and the circumstances of life. "Their primary interest is not to increase the financial assets of the world," he says, "but to broaden intellectual horizons." His second category is "creative research," the primary objective of which "is to discover, invent or produce new materials, new processes, new equipment or to find new uses for existing materials and equipment." Creative research, he says, might be called "producers' research," leading to the manufacture and sale of new and improved materials and equipment. Third, he proposes "applied research," the primary object of which is "to determine ways and means of applying to the solution of concrete problems the knowledge, material, equipment and processes made available by fundamental and creative research. It is a process whereby the purchaser or consumer may select intelligently the materials, equipment and processes best suited to his purposes and needs, to the end that increased efficiency, economy and safety may be realized in daily operations."

Further on in his paper Mr. Wallace develops clearly the fact that the railroads, like all consumers, are dependent upon the progress made by those who manufacture and sell the things which the railroads purchase. He also points out that, as the railroads interest themselves in the possibilities for the adaptation of new equipment or materials or functions to the purposes of railway transportation, research and development work are stimulated along many fronts in the industrial world. Thus is clearly suggested the effect of mutual stimulation of the applied research conducted by the railroads and the results of the creative research conducted by the manufacturing industries. Although less publicised than now, this relationship has been a commonplace of the railway industry throughout the century and more of its history. If it were to be written, that history would be a complete record of the advances in applied science and engineering method along America's entire industrial front.

Economy in Freight- and Passenger-Car Design

A study of the age distribution of freight-car inventory in the United States as of January 1, 1936, reveals that there were 763,863 freight cars more than 20 years old; 298,695 cars more than 16 years old; 431,991 cars more than 11 years old; and 279,957 cars more than six years old. The depression necessitated the use of many cars which normally would have been retired, and caused some of the poorest years in the annals of car-building history. With recovery from the depression well under way and, with the possibility that freight and passenger

cars will be built in increasing numbers, the railroads are facing decisions which will determine the extent of the savings to be effected by using materials for car construction which will reduce the tare weight of the cars, increase their capacity and reduce maintenance costs. During depression years, usually conceded as being the time when engineering development reaches its highest levels, low-alloy high-tensile corrosion-resisting steels have been developed which fit the specific need in the transportation field for effecting these savings in car construction. This fact has been appreciated by many railroad mechanical officers.

These high-tensile steels can be used in lighter sections than regular carbon steels for the same service because of the superiority of their physical and corrosion-resisting properties. The stress at the yield point of the high-tensile steels is usually between 50,000 lb. and 60,000 lb. per sq. in., whereas the yield point for low-carbon steels ranges between 25,000 lb. and 35,000 lb. per sq. in. The ultimate stress of between 65,000 lb. and 90,000 lb. per sq. in. for the high-tensile steels compare with ultimate stresses between 48,000 lb. and 65,000 lb. for regular carbon steels. The atmospheric corrosion resistance of the high-tensile steels, which is in some cases four to six times the resistance of plain steel, and its greater yield strength can be utilized for car construction in three ways: (1) In sections equal to regular carbon steel to reduce maintenance costs and lengthen the life of the car structure, with no reduction in weight; (2) in reduced sections to decrease the weight and increase the payload capacity, but with the same strength and same probable length of life as existing equipment, and (3) a compromise between (1) and (2), giving both a substantial increase in service life and a substantial decrease in weight.

In a discussion of savings to be effected by light-weight car construction using high-tensile steels, which followed one of the papers presented at the February 19 meeting of the New York Railroad Club, it was stated that such steels could not be used economically for car construction until the cost was approximately that of regular carbon steels. However, further discussion of the subject revealed that, when the cost of high-tensile corrosion-resistant steel is considered with relation to the strength of such steels, that is, the cost per unit strength, some high-tensile steels on this basis cost less than regular carbon steels. This is now the case because the cost of plain carbon steel has been advanced twice in the past two years while the cost of the high-tensile steels has remained the same, which fact was brought out in the discussion referred to above.

The tare weight of freight and passenger cars which must be moved in order to transport revenue loads is of vital importance to every carrier. Of equal importance is length of the life of the cars and the cost of maintaining them. Improvements in all these factors are being effected by the high-tensile corrosion-resistant steels, and they will undoubtedly have an increasing application in future car construction. This is evidenced by the fact that over 10,000 cars have already been built utilizing these steels.

NEW BOOKS

STEAM LOCOMOTIVE DESIGN: DATA AND FORMULAE. *By E. A. Phillipson, Assoc. M. Inst. C. E., A. M. I. Mech. E., M. I. Loco. E. Published by the Locomotive Publishing Co., Ltd., 3, Amen Corner, E. C. 4, London, England. 420 pages, 5½ in. by 8½ in., illustrated. Price, $7.50.*

The author has endeavored in this book to include only the essential theory of heat engines and application of mechanics, and to avoid repetition of the most elementary principles and abstruse academic theories which have but limited application to everyday practice. It is written in terms of British practice. Historical details and descriptive paragraphs are avoided, except where they affect present-day considerations of design. While the subject is treated largely from the viewpoint of the locomotive engineer, the book has been written to provide a reference on design for all those concerned with the construction, operation and maintenance of the steam locomotive and to meet the needs of the designer and the more advanced student for a text book covering the subject in the light of recent research and current practice. There are twelve chapters dealing with factors which must be considered before the design of the locomotive is begun; tractive force, power, adhesion and resistance; determination of principal dimensions; boiler design; superheating and feedwater heating; compounding, etc. Numerous drawings of details, etc., are provided, and an Appendix presenting ultimate tensile strength and other particulars of materials for locomotive construction as specified by the British Standards Institution.

DEVELOPMENT OF DRAFT GEARS FOR AMERICAN FREIGHT CARS. *By Wm. E. Gray and C. W. Messersmith. Published by Purdue University, Lafayette, Ind. 150 pages, paper bound.*

This book is a review of the developments leading up to the modern freight service draft gear. It brings into one book comprehensive information regarding practically all early types of draft gears as well as more modern types, this information having been available heretofore only in widely scattered sources. No effort is made to furnish operating characteristics or performance data on the various draft gears described. As stated in the foreword, few devices have been the object of greater inventive effort than the friction draft gear and over 12,000 patents have been issued up to 1927. An effort has been made to exclude draft gears which existed only in patent drawings and to include all draft gears actually constructed, but some have doubtless been omitted in cases where the builder, either through choice or neglect, failed to make a record. A new and hitherto unused system of classifying draft gears on the basis of type of gear action is suggested.

Gleanings *from the* Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

Railroad Hobbyists

Many hobbies have sprung up over night, only to die away in a few weeks, and make a goodly number skeptical about model railroading. The patience, skill and investment required in this hobby classes it beyond a "fad". When the newcomer has completed a freight engine, that calls for freight cars and the caboose, then the passenger power and the cars, then the shunting locomotive, more track, switches, signals, still more freight cars. It is easy so see that the model line is infinite.

Make It Fool Proof

I agree with you as to the advantages of air conditioning passenger cars, but in my opinion we still have a long way to go—on some railroads at least. The apparatus must be so improved as to be fully automatic and not require any adjustment or tinkering on the part of the train employees. Something is surely wrong when passengers are made extremely uncomfortable because of too great a spread between the inside and outside temperatures. I don't think much of the judgment of some employees in regulating the temperatures.

Failures of Locomotive Parts

With particular reference to the writings of F. H. Williams, covering failures of locomotive parts, we feel that this is presented in an able manner and shows the extent to which locomotive parts should be designed, machined and later inspected to avoid sharp edged corners and tool marks on finished surfaces, to insure desired service life of manufactured articles. Furthermore, we agree that the chemical and physical laboratory tests are necessary and important in railroad operation, through which medium the cause and reason for failures can be determined, and either improvement of design or better material offered to avoid repeated failure.

Skilled Workers Needed

It seems to me you should put still greater stress in your columns on the vital necessity of recruiting and training young men for the various trades and occupations in the mechanical department. Many of the railroads gave up this effort almost entirely during the depression. The shops were frequently closed for long periods, or ran on short time. Forces were cut down drastically, the older men being favored on a seniority basis. Many of these older men have since retired or have gone into other work. We are hard up against it now for skilled workers and our problem is not made any easier by the fact that the other industries were first to recover and have exhausted the supply of skilled labor. True, many men are still out of work and dependent upon their communities for subsistence. But these are largely unskilled laborers. In this group are too many young men who have never had a chance to learn a trade. Still other young men are coming along who need such training. The railroads must do their part in helping to develop these men for future usefulness, and they will be sorely needed when prosperity gets back into full stride. It is unfortunate that more roads did not follow the example of the Missouri Pacific in maintaining apprentice training throughout the depression; the wisdom of that accomplishment is now becoming evident.

Eyes That Do Not See

Strange, is it not, that we get into such ruts that we fail to see the foolishness or inefficiency in blindly following practices to which we have become accustomed? Possibly they were all right when they were inaugurated, but changing times have made them hopelessly out-of-date. Doubtless this is because our railroad organizations are so large and cover so much territory, although I have noticed the same failing in small industrial organizations, where all the operations were under one roof and where there was keen competition for business. One reason why I cannot get along without the *Railway Mechanical Engineer* is that it is concerned chiefly with informing us about the newest and latest developments and practices. It jolts me out of my self-complacency. And, sometimes, when you do get a good stiff jolt and wake up, the discarded practices look almost ridiculous. What fun a skillful cartoonist could have in showing up our weaknesses. It would be grim humor, but you might even start a column on commonplace practices which are all wrong. A suggestion box on one road has proved helpful in this respect.

Car Failures on Line

The big problem in the car department, and it seems to be getting worse rather than better, is the failure of various car parts in service, no matter how carefully they are inspected before leaving the terminal. These cause bad train delays; they may be classified as follows:

1—Car journals run hot.

2—Brake beams drop down, usually because of broken brake hangers (a new defect). Also broken brake heads, and broken brake-beam truss rods and fulcrums.

3—Trains break in two. This is not always caused by high and low couplers. Sometimes a knuckle may open without any apparent defect; indeed, when recoupled the train may run 150 miles or more to destination without further trouble.

4—Brakes stick after brake applications are made while the train is in motion, and sometimes after the so-called running test is made. Train lines also sometimes break.

5—Broken couplers and draft gears.

6—Broken arch bars and truck side frames.

7—Cast-iron wheels, because of shelling, brake burns, worn through chill, slid flat, etc.

Conservation of Man Power

The annual report of the Railroad Y. M. C. A. of Richmond, Va., contains this significant statement: "One of the most serious results of long unemployment is that it unfits men for useful work. Some of the older railroad men, who were laid off during the depression, when called back, found themselves unable to perform the usual duties required of them and were compelled to give up." Your publication called attention to the pre-depression days to the fact that new equipment, changing practices, etc., frequently caused the jobs to outgrow the skill of the workers who were unable to keep up with these changes. Your suggestion then was that the railroads, and industries as well, in order to protect their older employees, should provide special training, so that these workers could adapt themselves to the changing conditions and practices—I think you called it continuation training. Is it not time to put special emphasis on such training, especially with a view to conserving the workers such as are mentioned in the quotation? Do not the railroads, and society in general, owe something to these men? True, they may be to blame because of indifference and lack of initiative but nevertheless, they are with us and must find means of support. Surely their past experience and railroad background will be worth something in conjunction with their new training.

IN THE BACK SHOP AND ENGINEHOUSE

Joliet Locomotive Shop Devices

Several labor-saving devices now in use at the Joliet, Ill., shops of the Elgin, Joliet & Eastern are shown in the illustrations. The first of these, which also incorporates an important safety feature, is the pair of tire clamps used in connection with two short chain lengths and a link for attachment to the traveling crane hook when lifting a locomotive driving-wheel tire to or from the boring-mill table, moving it about in the wheel shop, etc. This type of tire-lifting device, while not an especially new design, is notable because of its simplicity, ease of application and safety, since there is no chance of its being disengaged while there is an upward pull on the lifting chains.

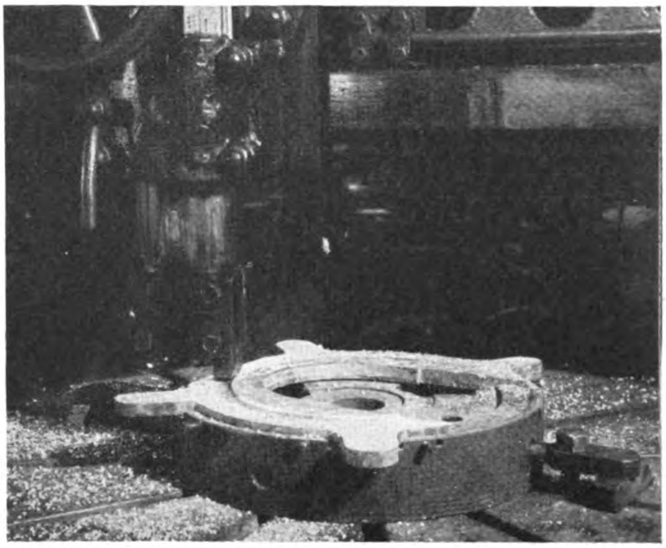
Each clamp is made, as clearly shown in the illustration, of a piece of 2-in. square stock about 11 in. long, bent at one end to fit around the contour of the tire flange and slotted at the other end to receive a ⅝-in. by 2-in. by 10½-in. lever which is pivoted on a ⅝-in. bolt and drilled at the upper end for connection to the chain link. An upward pull on the chain holds the hook end of the clamp firmly against the flange and it cannot be disengaged as long as there is tension on the lifting chain.

Horse-Shoe Hub-Plate Jig

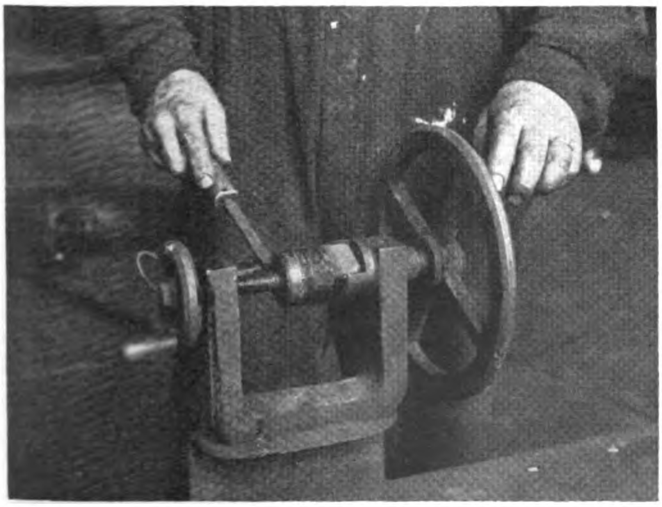
In order to avoid the necessity of dropping wheels when taking up trailer and driving-wheel lateral play, many E. J. & E. locomotives are equipped with removable brass hub plates which are attached to the trailer or driving boxes by special flat-head bolts through four projecting ears cast integral on the hub plates, these bolts extending through into the boxes so as to position the hub plates properly and being removable through holes between the wheel spokes. This allows a worn hub plate to be removed and replaced by a thicker one without dropping the wheels.

The hub plate is made somewhat in the form of a horse-shoe, being open at the bottom to accommodate the grease cellar. The hub plate is machined in a special cast-iron jig 20⅝ in. in outside diameter by 4⅛ in. high, being centered on the boring mill table and held down to the table, as well as held against turning, by means of four finger clamps, only one of which is illustrated. The horse-shoe hub plate, as received in the rough casting, fits into a recess 19⅜ in. in diameter by ⅜ in. deep in the top of the jig, the four ears projecting out through suitable openings. The hub plate is held against turning in the jig by means of these ears and is held against lifting out by means of seven ⅜-in. set screws arranged around the periphery of the jig. In order to prevent the hub plate from springing in under clamping pressure, two stops are cast on the jig which just fill the grease-cellar opening in the hub plate and thus add to the rigidity of the clamping arrangement.

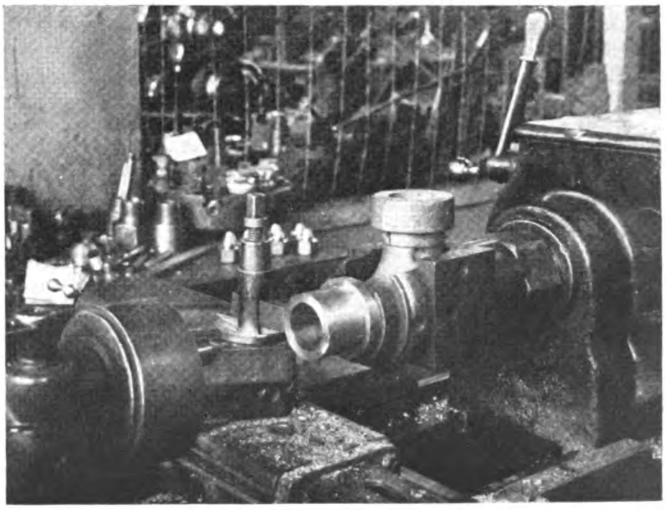
This cast-iron jig is cored on the inside to reduce weight. It is centered by means of a projecting center



Machining a removable horse-shoe hub plate in a special boring-mill jig at the Joliet shops



Hand-operated wash-out-plug chaser used in an enginehouse

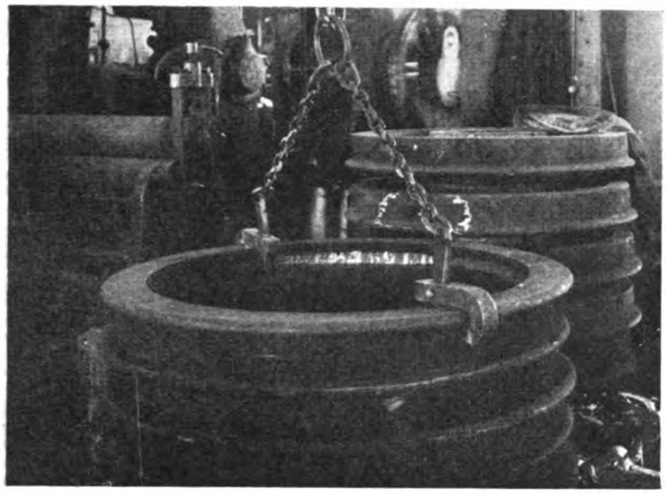


Jig for machining a boiler-check goose neck

piece 6 in. in diameter by $\frac{3}{8}$ in. deep, which fits into a center hole in the boring-machine table. The jig is driven by four finger clamps, as mentioned. A rough and a finish cut are taken on one side of the hub plate which is then turned over and machined to the required thickness.

Goose-Neck Machining Jig

A special jig for machining boiler check goose necks is shown in the illustration. This consists of a recessed steel block $4\frac{1}{2}$ in. square by $4\frac{3}{4}$ in. long, threaded on one end to fit the brass lathe spindle and threaded on the other end $4\frac{5}{8}$ in. in diameter by $1\frac{3}{8}$ in. long to receive a brass collar (shown on the lathe dead center) which serves to bring the goose neck squarely up against a spacing collar on the jig and centers it with respect to the lathe spindle and dead center. This permits turn-



Tire-lifting clamps which combine simplicity, ease of application and safety

ing, facing, boring and threading the ends of the goose neck with a minimum of set-up time and the assurance that the goose neck will not be ripped out of some insecure clamping arrangement on a face plate or chuck. Extra brass clamp adapters are available for different sizes of goose necks.

Wash-Out Plug Chaser

A simple little device which proves a great convenience in enginehouse work is the wash-out-plug chaser, shown in the illustration. The threads of brass wash-out plugs, even when removed every 30 days, frequently become pretty well filled with lime, carbonized oil and other foreign material which is difficult to remove by ordinary hand methods, especially without some damage to the threads.

The device shown in the illustration consists simply of a hand wheel and chuck arrangement for turning the wash-out plug while a hand thread chaser is used to run up the thread and clean out all foreign material without removing any metal. The entire jig is mounted on a U-bracket made of 2-in. by $1\frac{1}{4}$-in. stock measuring 8 in. between the vertical sides and 6 in. high. This bracket is bolted to a supporting plate on a tool box and equipped with a 12-in. hand wheel, friction bearing and driving jaw on one side and a tail stock with a 4-in. hand wheel and $\frac{3}{4}$-in. screw on the other side to hold the wash-out plug in the driving jaw and also center it. The driving jaw also is equipped with a center so that the wash-out plug will run true. A tool rest is provided parallel to the center line of the device and on the side next to the workman. This serves as a guide and support for the hand-operated thread chaser tool as it is moved parallel to the axis of the wash-out plug and cleans out the threads.

Locating Dead Centers on Gas and Diesel Engines

The matter of accurately determining the exact dead center of some internal-combustion engines, due to their construction, is often an awkward procedure. The location and size of the spark-plug or injection-nozzle openings discourage the usual practice of feeling for the piston through these holes. In such cases, the crank case must be opened and the crank cheeks plumbed by the means of a bevel protractor.

Due to the inaccessibility of a machined surface known to be at the correct angle from the cylinder center lines, the protractor cannot be checked properly to determine whether the engine is level—a fact which depends en-

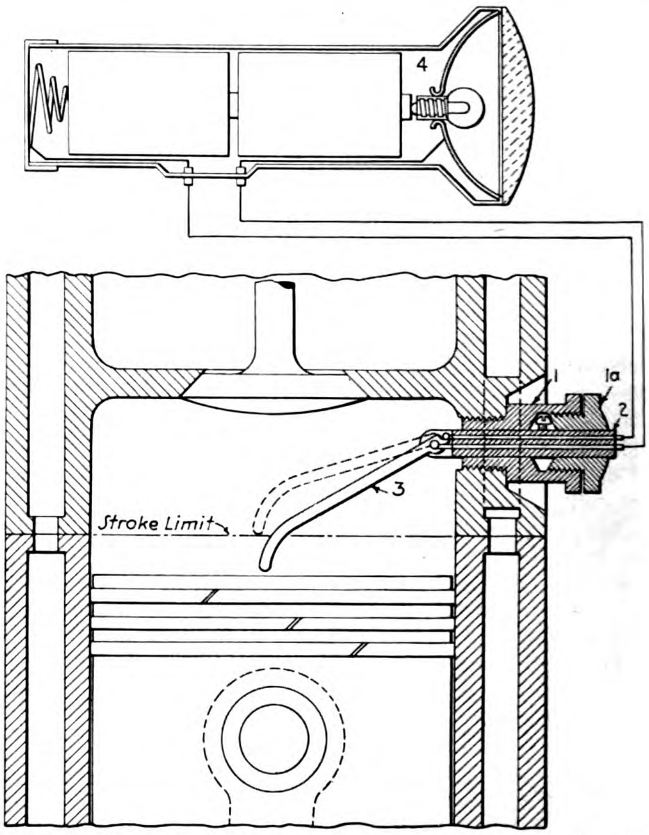


Fig. 1—Device for locating dead centers and timing ignition of internal-combustion engines

tirely on track conditions and the poise of the car or locomotive in which the engine is mounted.

A device that can be used to locate these dead centers easily and accurately is shown in Fig. 1. The material required for making the device is a spark plug, a flashlight, a short piece of round fiber rod, some pieces of $\frac{1}{8}$-in. and $\frac{3}{16}$-in. Tobin bronze welding rod and some short lengths of insulated wire. This device will not only give the piston position accurately but also lets the operator know when the piston is on the compression stroke without dismantling the cylinder-head covers or valve panels to expose the action of the intake valve. Fig. 1 shows the design and application of the device to a vertical, valve-in-head motor of conventional design. Fig. 2 illustrates its use in dead-centering and timing the

ignition of a 12-cylinder, four-cycle, valve-in-head motor.

To make the device, a spark plug is first procured, the porcelain insulator is then removed, and the holes in both members of the spark plug are reamed to accommodate a straight cylindrical insulator made of fiber. This insulator *2* is shown in Fig. 3. The assembly of this insulator and the reamed spark plug is shown in Fig. 4. One end of the insulator is slotted to provide jaws for the hinging of the feeling lever *3*. The insulator *2* is drilled longitudinally to receive the hinge electrode *2a* point near its upper stroke limit (¼ in. is sufficient). It is obvious that as the piston approaches the upper limit of its stroke and encounters the feeling lever *3*, the flashlight circuit is broken and the light goes out. Now, if crankshaft be turned further in the same direction, the piston will reach its stroke limit, after which it descends. When it reaches the exact spot at which it contacted lever *3* on the up stroke, it will again release lever *3*; this closes the flashlight circuit causing it to light until the next interference by the piston on its next

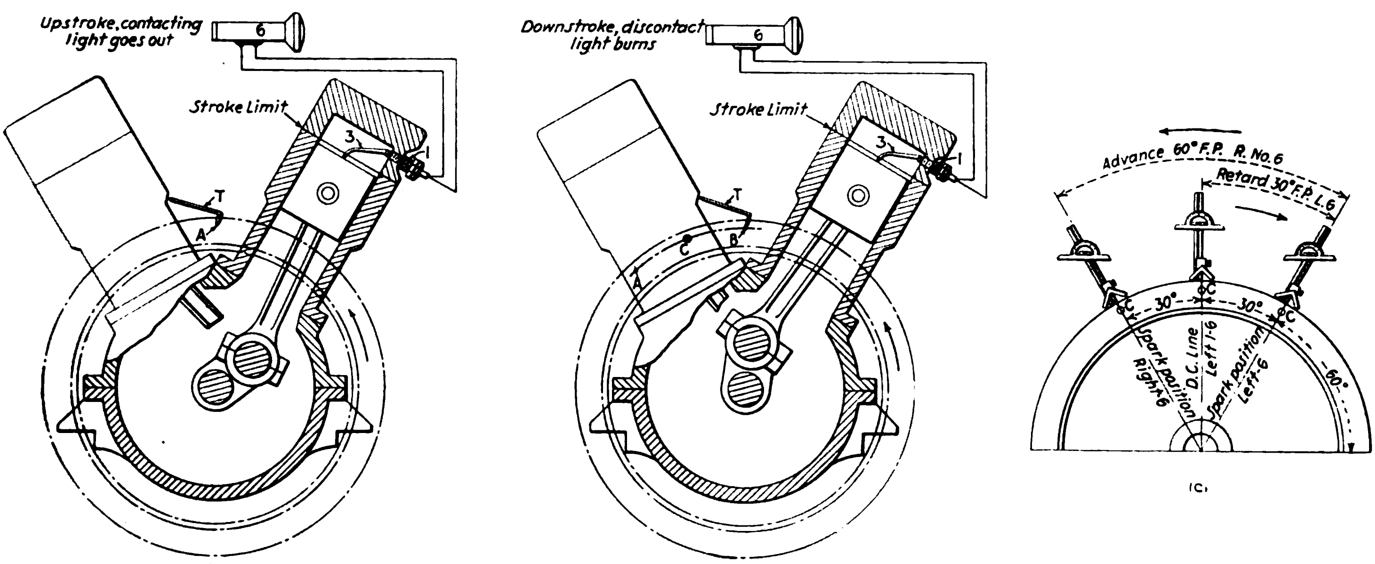


Fig. 2—Application of the device for locating dead centers and timing ignition of a 12-cylinder four-cycle V-type engine

and contact electrode *2b*, which are secured in a functional position by the set screws *2c*. A small vent groove *2d* is cut along one side of insulator *2* as shown in Fig. 3. This vent provides a means of compression escape and serves also as a warning port when determining the compression stroke of the cylinder. Both electrodes *2a* and *2b* have one end bent at right angles to form an L shape. These L ends are sawed short enough to bridge the space between the jaws of the insulator *2*. The L section of the lower electrode *2a* acts as a fulcrum for feeling lever *3*. Lever *3* is provided with a limit lug *3a* as shown in Fig. 3, which limits the downward swing of lever *3* to a fixed angle by its contact with upper contact electrode

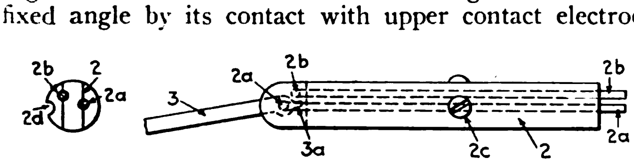


Fig. 3—Fiber insulator for the spark-plug assembly

2b. Since electrodes *2a* and *2b* are conductors of electricity and are completely insulated from each other by the fiber body *2*, it is obvious that lever *3* through its limit lug *3a* provides a means of making and breaking an electrical circuit. Hence, the assembly forms an effective and sensitive switch for the flashlight *4* shown in Fig. 1, from which the regular switch has been removed. The terminal of the flashlight *4* are wired directly to the locator as shown in Fig. 1. By using No. 6 machine screws for set screws *2c*, and so locating them that their heads occupy the recess formerly occupied by the flange of the porcelain, a means is provided for securing the insulator *2* in position within the outer shell *1* and *1a*. The shape of feeling lever *3* is such that when the device is screwed in the regular spark-plug hole, its feeling end will contact the piston when the latter has reached a

stroke. Since air will be expelled through a spark-plug or fuel-nozzle hole only on the compression stroke of a four-cycle engine, when turned in its intended direction of rotation, the vent *2d* shown in Fig. 3 serves to warn the mechanic that the piston is approaching the position desired for locating the first dead center.

A tram should be used with this device to locate dead centers. This tram should be fulcrumed from some fixed object or part of the engine and scribing should be done either on the face or rim of the flywheel. To avoid confusion in taking protractor readings, the tram should be of a length that will fix a point on a vertical line with the crankshaft. However, this is not imperative. After the tram is procured and the device is in position in the cylinder with the proper connections made to the flashlight, the flywheel is turned in the direction of rotation until air is expelled from vent port *2d*. Continue to turn carefully in the same direction until the first flicker of the flashlight, then stop. Scribe a short line across the face of the flywheel with the tram,

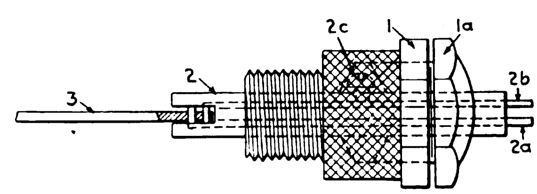


Fig. 4—Spark plug with insulator assembled

as shown in Fig. *2a* at *A*. Now again turn the flywheel carefully in the same direction. The flashlight will now be observed to be not burning. Continue the turning until the next flicker of the flashlight, indicating the point of re-contact, and stop. Now with the tram make another mark *B* on the flywheel, as shown in Fig. *2b*.

Next with a pair of hermaphrodite calipers, scribe an

arc parallel with the perimeter of the flywheel, bisecting marks *A* and *B,* shown in Fig. 2*b*. With a pair of dividers, locate a center mark *C* equidistant between marks *A* and *B*. Turn the flywheel back until the tram registers with the center mark *C*. This places the piston of the cylinder to which the device was placed on its exact dead center, regardless of the angularity of the cylinder center line of the motor.

Timing the Camshaft of a 12-Cylinder four-cycle Engine

When timing the camshaft of a 12-cylinder, four-cycle gasoline engine, the intake of which is to start 10 deg. in retard, the left No. 6 piston is the most convenient to dead center. As cylinders No. 1 and 6 are running mates, that is, their crank pins are at the same angle, the No. 1 and No. 6 pistons are on dead center at the same time. Hence, the dead-center mark that was just located for left No. 6 will serve for left No. 1 as well. Now with a bevel protractor, with its blade registering with the dead-center mark *C*, adjust the spirit level of the protractor so that its bubble neutralizes. Note at this time, the reading in degrees of the protractor. If the engine is level and the tram was made as suggested, it should read 90 deg.

Next set the protractor to read 100 deg., and with its blade still on the dead-center mark, turn the flywheel in the direction of rotation until the bubble of the spirit level of the protractor again neutralizes. Check the position of the intake valve of left No. 1 cylinder. It should just start to open with the flywheel in this position and if the tappet clearance is properly adjusted. If it does not start to open, the timing gears or chain should be unmeshed, and the camshaft should be turned until the left No. 1 intake valve just begins to open. The gears or chain should then be remeshed. To time the camshaft of the right-hand section of the motor, set the protractor to read 160 deg., turn the flywheel further in the direction of rotation until the spirit level neutralizes, and then check and correct the right camshaft the same as was done with the left.

Timing the Ignition of a 12-Cylinder four-cycle Engine

Left Side—When timing the ignition on the left side of a 12-cylinder, four-cycle gasoline engine, the ignition of which takes place 30 deg. in advance, set the protractor at 60 deg., turn the flywheel against rotation until the spirit level neutralizes when the blade is registering with the dead-center mark *C* shown in Fig. 2*b*. With the flywheel in this position, the left distributor should be so set that its breakers are just separating when the high-tension rotor is in communication with the left No. 6 terminal. The same applies if magnetos are used. If correction is required, the distributor or magneto shaft gears should be disengaged, and the distributor or magneto shaft should be turned in its direction of rotation until the breakers just begin to separate. Where dual ignition is used, care must be taken to avoid confusion in setting distributors and magnetos, since one of these operates in a clockwise direction while its mate operates in a counter-clockwise direction.

Right Side—When timing the right-hand side of the engine, set the protractor at 120 deg. and turn the flywheel in the direction of rotation until the spirit level of the protractor neutralizes with the blade registering on the dead-center mark *C* shown in Fig. 2*b*. Recheck or correct the right distributors the same as was done with the left. Fig. 2*c* illustrates the setting of ignition for a 12-cylinder, four-cycle engine as herein described. Since the connecting rods on the right side of a 12-cylinder engine connect to the same crank pins as do the connecting rods on the left side, and since the cylinder center lines are at an angle of 60 deg. from each other, it is obvious that one dead-center mark will serve both sections of the engine by protracting the intake and ignition events of the right section exactly 60 deg. in retard of the same marks of those of the left side.

It is good practice to stencil the flywheel at the time each event position is protracted. With the flywheel set in the position of each event as ruled by the protractor, strike a mark on the flywheel and permanently prick punch or birdseye punch that mark on the flywheel. These may be identified by appropriate abbreviations: for example, "F.P.L.6" could be used to designate

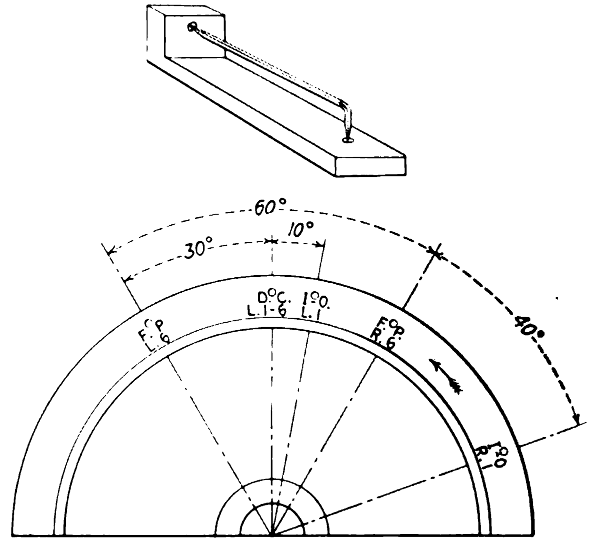


Fig. 5—Master gage for tram and flywheel layout with permanent timing and dead-center marks

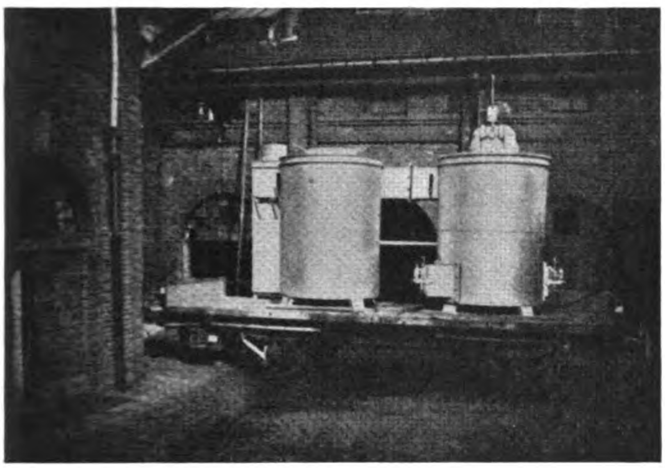
"firing point Left No. 6." Then in the event of future time checkings or dead centerings, it would only be necessary to use the tram and turn the flywheel directly to the mark sought for rechecking, thus eliminating the use of the locator and bevel-protractor that are only required for the initial layout of the flywheel. Much time can be saved by this practice. The tram should be carefully preserved by the mechanic responsible for the maintenance of the motor. A simple master gage made of bar stock should be kept with the tram, to check it for correct length from time to time. Such a tram and master gage, and also the flywheel layout, are shown in Fig. 5. The layout marks shown in Fig. 5 have the following meanings: "F.P.L.6" locates the firing point of the left No. 6 cylinder; "D.C.L. 1-6" locates the dead-center position of left No. 1 and left No. 6 pistons; "I.O.L. 1" locates the point where the intake valve of left No. 1 cylinder is just beginning to open; "F.P.R. 6" locates the firing point of the right No. 6 cylinder; and "I.O.R. 1" locates the point where the intake valve of the right No. 1 cylinder is just beginning to open.

This device may be used in locating dead centers of Diesel engines in timing their admission and fuel-injection periods. The outer shell of the locating device, however, would have to be made to fit the glow-plug holes or injection-nozzle holes, whichever is the most convenient. A flashlight is recommended for use as a signal for this device for the reason that a light of higher voltage would arc at the electrode contacts when the piston makes its up-stroke contact.

Hardening Crosshead Guides In Salt-Bath Furnaces

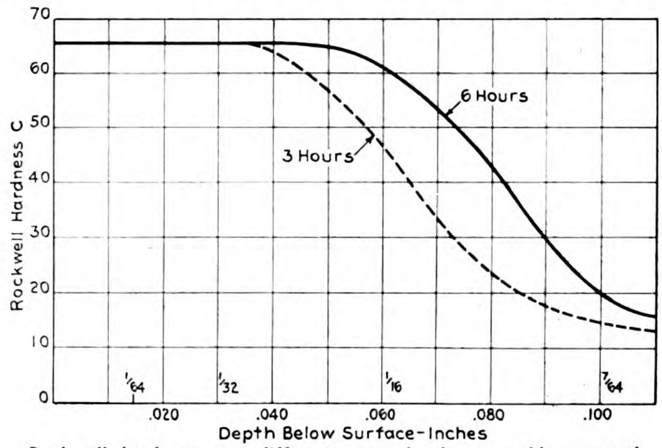
The case-hardening of crosshead guides has presented an expensive problem for the German State Railways for many years. When repairs are judged necessary, the practice is first to test the guides for hardness, and if a figure of less than 60 Shore is obtained the guides are carburized. In order to obtain the most economical results, guides are sent to a central shop for hardening so that the furnace plant can be operated continuously throughout a 24-hr. day.

One such central shop is located near Bremen where it was ultimately found necessary to take care of from



Salt-bath furnace at Bremen, Germany, for case-hardening crosshead guides

100 to 150 guides per month. Since the pack-hardening type of furnace which was installed at this plant had a maximum output of only 120 guides per month, it was decided to investigate the possibilities of salt-bath furnaces for this work. Molten-sodium-cyanide furnaces have long been used for case-hardening small steel parts which require a maximum penetration depth of only 1/32 in. However, the possibilities of the process have recently been extended by the development of deep-cementation compounds of a type which, in Europe, are marketed under the name of "Durferrit C 5." Briefly, the main advantage of such compounds is that they enable a case of 0.045 in. to be obtained in 3 hr., and a case of 0.075 in. in 6 hr. Furthermore, the eutectoid zone obtained with this latter process is from one half to five-eighths of the total depth of the case, which permits the removal of considerable stock by grinding, without exposing the soft core of the guide. This grinding is

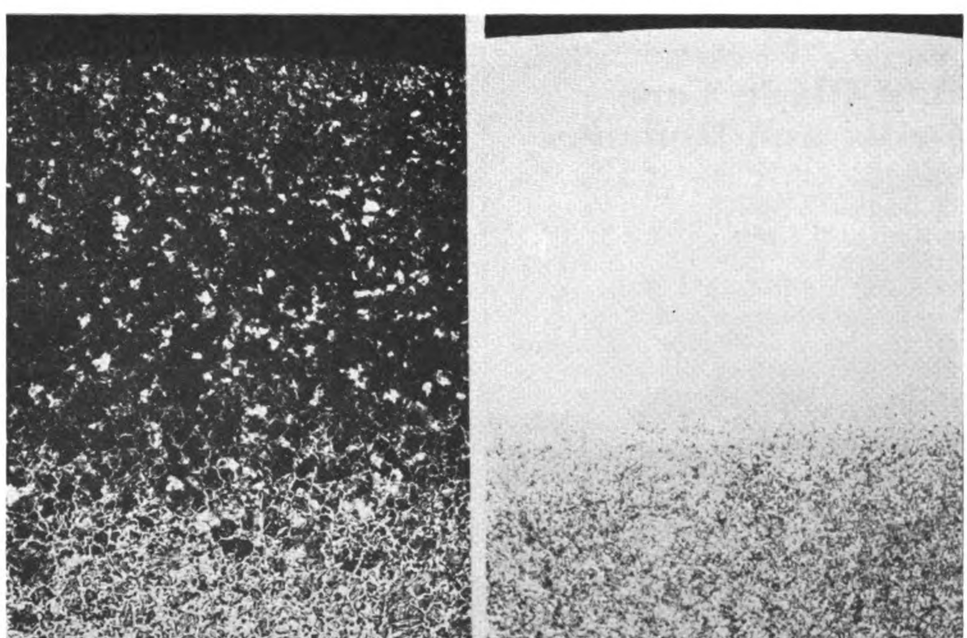


Rockwell hardnesses at different case depths on guides treated for 3 hr. and 6 hr.

necessary in order to correct any distortion which may have occurred in the furnace.

Largely as a result of the increased speed of working rendered possible by the process, it was decided to install a salt-bath furnace for the purpose of taking care of the increased output of 150 guides per month. The furnace that was installed has a pot diameter of 14 in. and a depth of 78 in. and, like the pack-hardening furnace which it replaced, it is oil fired. The guides to be hardened are suspended vertically in the molten bath. Waste heat is passed through a preheater where it serves to preheat the next component to be treated. The oil burners, of which there are two, operate under an air pressure of 16 in. of water, and consumes 1½ gal. of oil per hr. Combustion requirements demand 425 cu. ft. of air per min. Under these conditions the average life of the bath is between 700 and 800 working hours.

A certain amount of distortion is inevitable in any



Microstructure of case-hardened guide at different magnifications

case-hardening operation, but it has been definitely ascertained that the amount of distortion is less in the salt-bath process than when the pack-hardening method is used. In addition, a comparison of the old and the new methods shows an interesting economy in fuel resulting from the change-over; the essential cost data for the two methods are shown in the table. The graph shows the Rockwell C hardnesses obtained on work which has been carburized in the salt-bath furnace for 3 hr. and 6 hr., respectively, at a temperature of 1,760 deg. F. It will be noticed that the depth of case obtained by the process is 0.045 deg. in 3 hr. and 0.075 deg. in 6 hr. and of these cases 0.025 in. and 0.040 in., respectively, are "glass hard." The structure of the case obtained is shown in the microphotographs, which indicate that no free cementite is present, and that more than half the case is completely saturated with carbon.

Cost of Hardening Crosshead Guides by Pack-Hardening and Salt-Bath Methods

	Pack-hardening method *	Salt-bath method
No. of guides per heat	4	1
Carburising time, hrs.	12	3
Total time for four guides, hrs.	12	12
Weight of hardening compound, lb.	106	...
Weight of salts, lb.	...	9
Oil consumption in 12 hr., gal.	79.5	18.5
Cost of oil used in 12 hrs.	$8.66	$2.02
Cost of hardening compound	$2.06	...
Cost of salts	...	$2.16
Incidental costs per 12 hrs.	$2.40†	$1.92‡
Cost of insulating ends of guides with asbestos and clay per 12 hrs.	$0.24	...
Cleaning guide before carburising, and reheating ends subsequently per 12 hrs.	...	$0.96
Wages for 12 hrs.	$3.08	$3.08
Total cost per 12 hrs.	$16.44	$10.14
Cost per guide	$4.11	$2.53

* Two furnaces.
† Wear and tear on boxes.
‡ Wear and tear on crucible and pyrometer thermocouple.

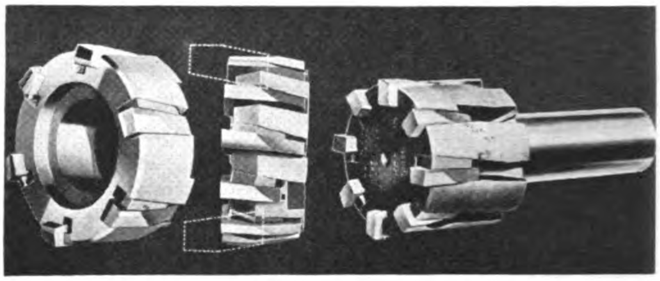
In summarizing the advantages of hardening guides in salt-bath furnaces, it is seen that the cost per guide is $2.53 as against $4.11 with the pack-hardening method; that less time is required for carburizing; and that although the depth of the case is practically the same for both methods, the distortion is less with the salt-bath furnace.

Ray Blade Core Drills and Reamers

The Ingersoll Milling Machine Company, Rockford, Ill., announces that the Ingersoll ray blade can now be applied to the heads of solid-shank or shell-type core drills or reamers. The double-tapered ray blades are locked against the thrust of the boring cut. When worn they are reset any amount by moving them outwardly for resizing and forward to compensate for the major wear of end cutting.

The ray blade is a double-tapered blade positively locked in the cutter housing with a compensating serrated wedge. The cutter blade is tapered along its length so that it will not push down or back from the thrust of the cut. It is further dovetail tapered across its width to prevent it from pulling out of its locating slot. The blade is retained in position by a double-tapered serrated wedge. As the cutter blade is moved outward for regrinding for wear, the clever shape of the wedge permits its movement, either further along or down its serrated slot. The wedge thus compensates for the thinning movement of the ray blade.

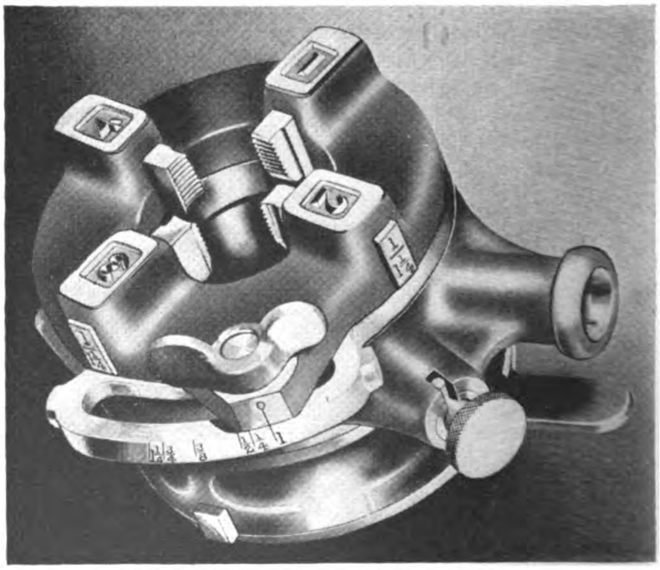
Ingersoll ray-blade boring heads are furnished with blades of high-speed steel, super-high-speed steel, Stellite, or tipped with cemented carbide fitted into housings of forged and heat-treated alloy steel. The shape of the blade makes it particularly economical for cutters with Stellite blades.



Shell-type and solid-shank boring heads for core drills or reamers with Ingersoll Ray blades

Wide-Range Ratchet Die

The illustration shows a ratchet die for threading pipe ranging in diameter from ¼ in. to 1¼ in. Three sets of dies, each for threading two sizes, can be changed quickly and are fully adjustable for cutting standard, oversize and undersize threads. The first set of dies cuts threads from ¼ to ⅜ in., the second set cuts threads from ½ to ¾ in., and the third set cuts threads from 1 to 1¼ in. A three-jaw self-centering chuck centers the pipe in the ratchet without the aid of bushings or grip screws. The threading dies are above the face of the stock so that the chips fall away from the thread as they are being cut. The ratchet and ratchet pawl are of extra-heavy air-furnace malleable iron and have a rust-proof finish. The die, designated as the No. 60-R ratchet, is manufactured by the Beaver Pipe Tools, Inc., Warren, Ohio.



The Beaver ratchet die for threading pipe which has a range from ¼ in. to 1¼ in.

With the Car Foremen and Inspectors

Box Car Rebuilding on the E. J. & E.

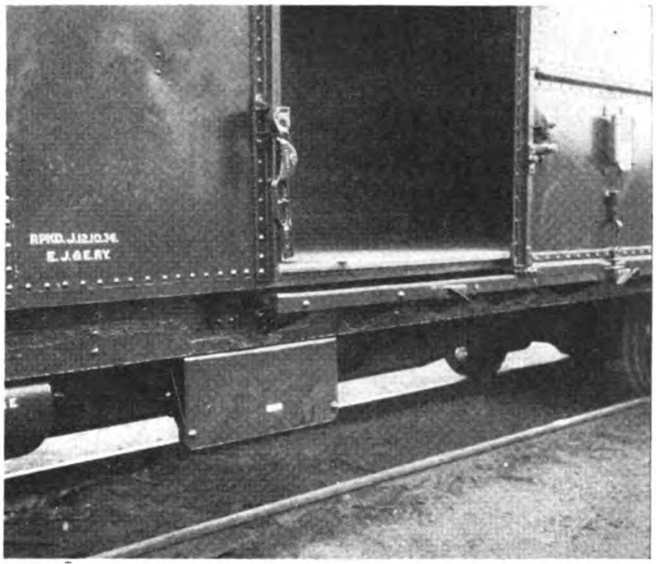
The Elgin, Joliet & Eastern is now rebuilding a series of 450 forty-ton U. S. R. A. box cars into a modern design with Pullman Standard Cor-Ten steel sides, Murphy rigid steel roofs with depressed running boards, Creco side doors, Miner and Peerless draft gears, Type-E couplers with bottom-operated lifting lever, Cardwell-Westinghouse snubbers, Type AB air brakes, Miner power hand brakes and Apex defect card holders. The original cast-steel trucks of the Andrews type are retained and equipped with one-wear rolled steel wheels.

By the use of the pre-fabricated thin steel car sides, the inside car width is increased from 8 ft. 6 in. to 8 ft. 9½ in. and the elimination of carlines by the use of the new rigid steel roof provides a slight increase of inside height from 9 ft. to 9 ft. 2 in. The new car is 40 ft. 6 in. long inside and weighs 44,600 lb., as compared with 45,400 lb. for the old car.

Among the important changes in the detail design and construction of the rebuilt cars, as compared to their predecessors, is the use of a floor reinforcing angle applied longitudinally between the center sill and each side sill to give additional strength for heavy trucking operations on the floor. Modern lightweight alloy steel sides replace the former wooden sides, the original Murphy steel ends being retained. A Murphy rigid steel roof replaces the flexible steel roof formerly installed.

A small but rather important detail in connection with the floor design is the application of post fillers, as shown in one of the illustrations, longitudinally over the side sill and extending the width of the post. This eliminates fitting the decking around the side posts and supplies a firm support for the bottom lining boards, which protects them against displacement through load shifting or trucking movements. Another feature is a shield made of ¼-in. by 15-in. by 30-in. steel plate riveted to the bottom of the side sill and suitably braced, as shown in another illustration, this shield serving to protect the service and emergency portion of the AB brake valve which, when left exposed, is frequently damaged by trucks when backing up to the car door.

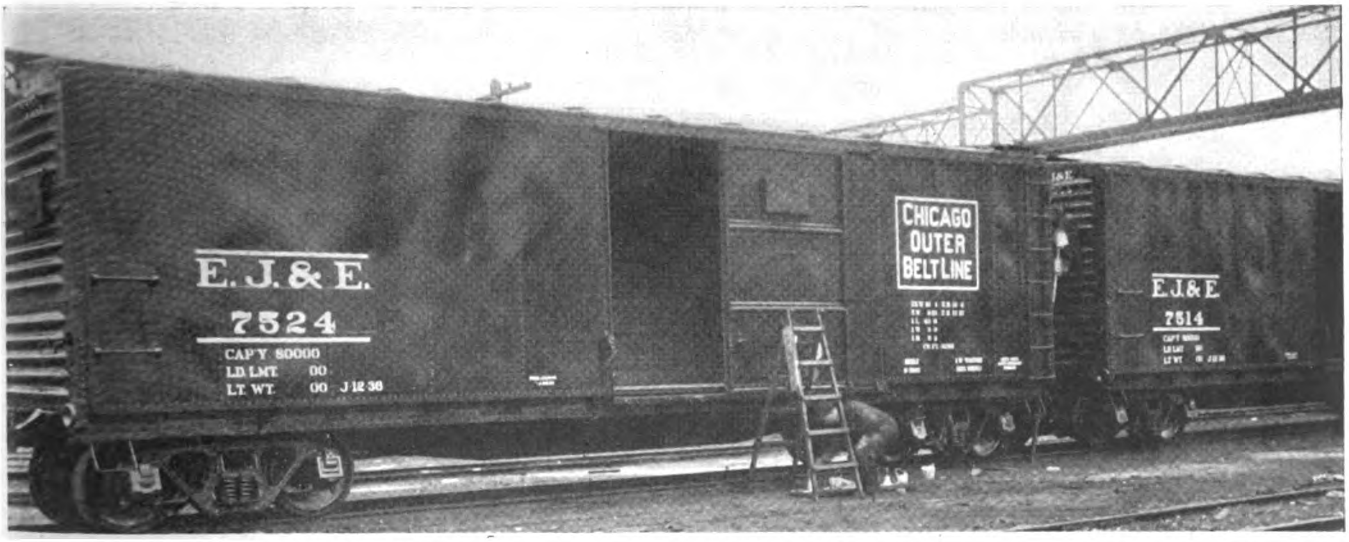
To facilitate repairs, the side ladders are attached at the top to the W-section and at the bottom to the side sill in such a way that it is not necessary to go into the car



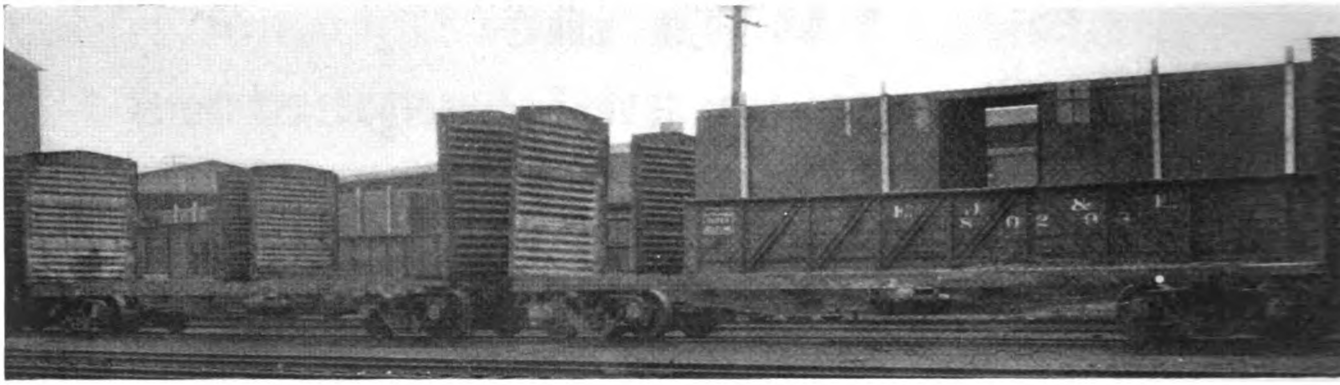
Steel plate applied as a protection in front of the Type AB brake valve

and tear out the lining to renew or replace ladder bolts. End-sill grab irons also are applied to brackets below the bottom line of the end sill for the same purpose. Metal brake steps are applied. No effort is spared to make the car watertight, especial attention being given to the corner caps which are carefully welded at all joints.

An interesting feature of the inside finish of the car is the use of a door-post filler made in two pieces, one of



Rebuilt box cars being stenciled outside at Joliet shops



Car frames stripped ready for rebuilding—New Cor-Ten steel sides (loaded on gondola in background) as received from Pullman-Standard ready for application

which is a 1½-in. by 2¼-in. section set in the corner and used as a nailing strip for grain doors. This inserted strip can be readily renewed when necessary without removing and replacing the entire door-post filler piece. The end lining is made of the same material as the floor, being 1½-in. yellow pine. A feature of this construction is the use of a strap, made of ¼-in. by 1½-in. steel, set in horizontally at a level of about 48 in. above the floor and bolted through the end lining into the steel end. This steel strap has been found an important aid in keeping the lining in place under impact shocks when the car is in service.

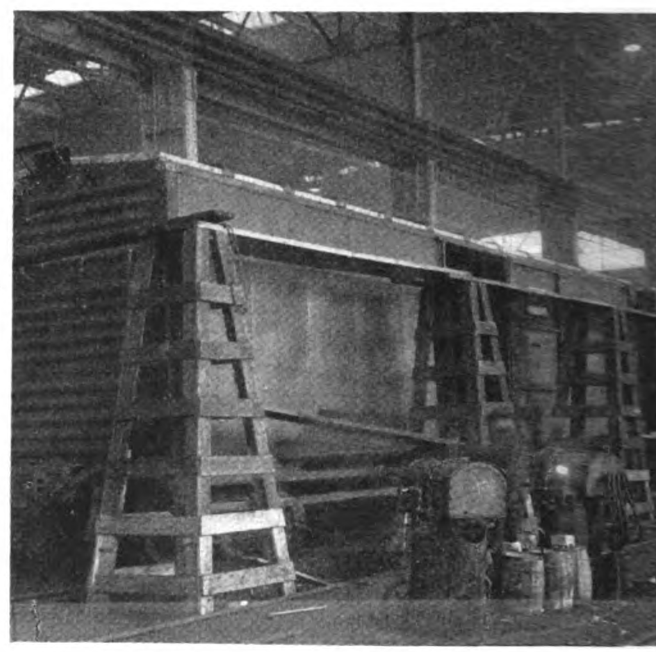
Description of the Rebuilding Operations

The cars are stripped of all wooden parts down to the underframe on a stripping track outside of the main shop, the ends being the only part of the superstructure retained. The cars are moved to another station outside of the shop where the ends are removed and sent to the hydraulic press for straightening. Underframe repairs are made at this station, also truck repairs, and AB brakes applied with extra-heavy piping.

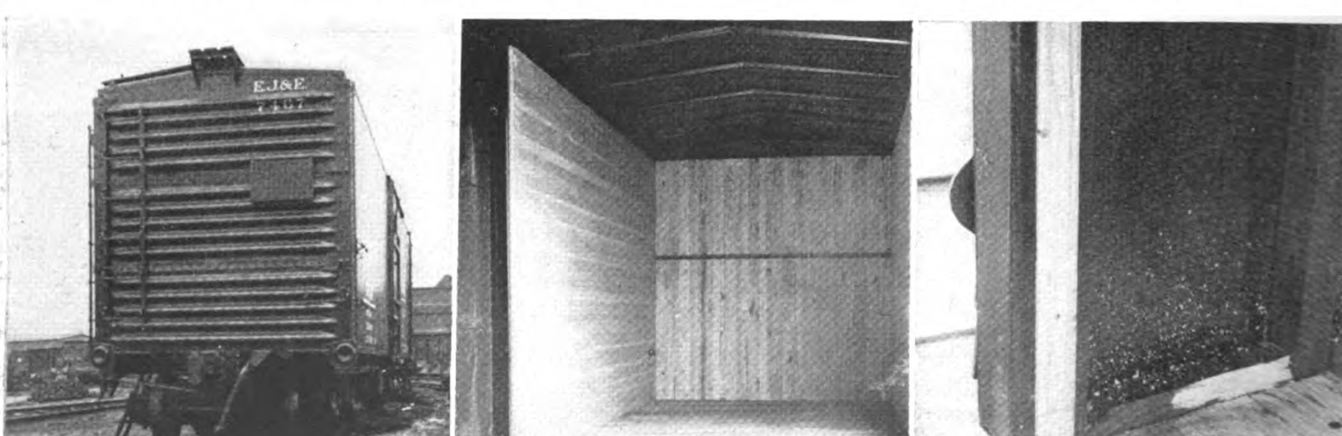
The cars then move into the shop to a station where the sides and ends are applied, the latter having been drilled with any necessary holes for new applications, such as end ladders, power hand brake, etc. The sides, shipped from the manufacturers compactly loaded in low-side gondolas, are applied with the shop crane inside the shop, using an equalizer bar with special clamps attached to the W-section. This arrangement avoids any tendency of the light side panels to buckle.

At the next station, all holes in the sides and ends are reamed, and rivets, later to be blanked, are driven at this time. The roof, assembled and driven on a jig on the ground, using special pneumatic riveting tools, is applied, an equalizer lifting bar being used in this instance also to avoid buckling of the light roof structure. Next, the doors are applied, also the corner caps; inside corner bands and caps are applied and riveted.

Side ladders are applied and roof rivet holes reamed. Four hammer operators are used in riveting the roof,



The station where car sides and ends are riveted



End of rebuilt car (left)—Interior lining, floor and roof (center)—Detail of door post and side-post filler (right)

each driving one-half of a side and one-half of an end. The hammer man works on the inside where a scaffold is provided. A two-tier scaffold on the outside provides convenient footing for the rivet buckers. At the corners, rivets are driven from the top down to where they can be reached by the ground man.

The car moves to the next position where one man at each corner drives the remaining rivets. The flush running boards are applied with the bolts having slotted heads tightened with an electric screw driver.

The steel work is completed and the car moved with a tractor outside of the shop to a position where creosoted wood side nailing posts and the end nailing fillers, also side post fillers, are applied. The entire inside of the car is given one coat of mineral paint (the priming coat having been previously applied). Floors are applied, consisting of 2½-in. yellow pine, bolted with waterproof bolts. The side lining consists of 3¼-in. wide vertical grain fir applied the full length from door posts to ends. The end lining is applied as described.

Cars are spray painted and stenciled in accordance with the usual practice. An output of five cars a day is secured with a total force of about 270 car men.

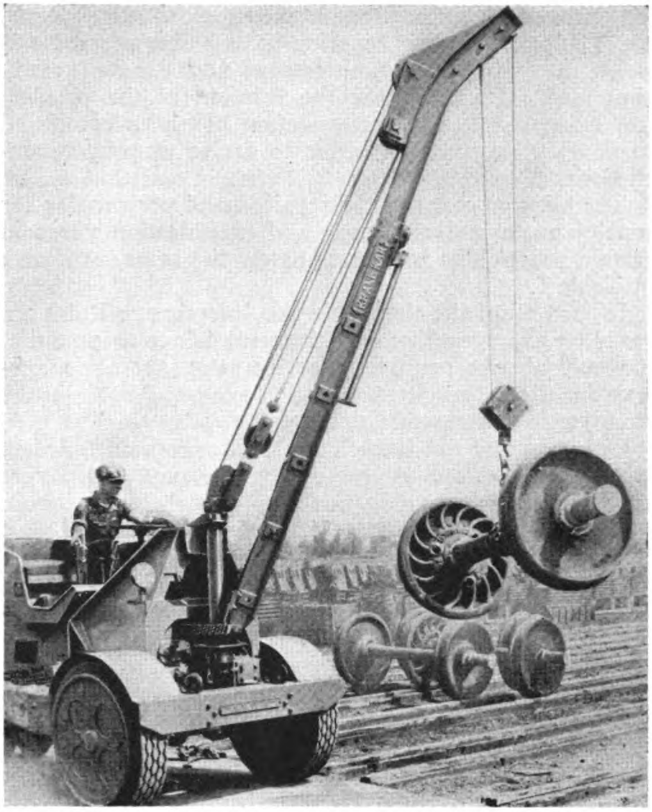
Diesel-Powered Industrial Crane

The industrial crane shown in the illustration is one of two standard self-propelled live-boom units manufactured by the Silent Hoist Winch & Crane Company, Brooklyn, N. Y. Each of these standard cranes, which have capacities of 5,000 lb. and 10,000 lb. respectively, are called "Krane Kars," and are powered with a Buda "Hivelo" four-cylinder engine capable of developing 55 hp. at 2,700 r.p.m. and 26 hp. at 1,000 r.p.m. The chassis of both cranes are of welded-steel construction with 36-in. diameter by 10-in. wide rubber-tired tractor wheels in front at the base of the boom, and 24-in. diameter by 5-in. wide rubber-tired steering wheels at the rear. They are furnished complete with power-swinging power-topping booms, electric lighting and starting equipment, air cleaner, oil filter, front bumper, a two-man seat, four lashing hooks, and a tool box as standard equipment.

The load hoists and boom-topping hoists of these cranes are operated by enclosed self-contained reversing mechanisms with ½-in. cables of 5,000-lb. single-line capacity winding on 7-in. drums. The boom-topping hoist operates entirely independently of the load hoist. The boom swing is controlled by a self-locking worm and sector and is automatically held in any position of swing. Automatic positive limit stops are provided to control the swing and topping motions of the boom.

The 5,000-lb. capacity crane can manipulate a 5,000-lb. load at a 5-ft. radius; this gives a clearance of 3½ ft. at the front of the crane. In a diagonal position the capacity is 7,000 lb., while at 10-ft. radius the capacity is 2,500 lb. The standard boom is 11 ft. long but 14-ft. and 17-ft. telescopic booms are also available. The overall width is 5 ft. 6 in., the overall height is 7 ft., and the overall length is 10 ft. 7 in., exclusive of the boom. This model has four traveling speeds up to 15 m.p.h. as well as one reversing speed. The hoisting speed, with power take-off in high gear, is 50 to 80 ft. per min. Boom-topping from horizontal to vertical requires 8 sec. The boom can be swung through 180 deg. in 15 sec. The 5,000-lb. capacity crane weighs 14,500 lb., exerts 4,500 lb. tractive force and has a turning radius of 12 ft.

The 10,000-lb. capacity crane can manipulate 10,000



A 5,000-lb. capacity Krane Kar in service on the Missouri Pacific

lb. at a 5-ft. radius which leaves a clearance of 3½ ft. in front of the bumper. The capacity at a 10-ft. radius is 5,000 lb. The standard boom is 12 ft. long but 14-ft. and 16-ft. telescopic booms are also available. The crane has four forward speeds up to 12 m.p.h. and one reversing speed. Load hoisting is accomplished on a three-part line at speeds of 35 to 55 ft. per min. with power take-off in high gear. The topping-boom can be raised from a horizontal to a vertical position in 10 sec. The boom can be swung through 180 deg. in 19 sec. The overall width of this model is 6 ft. 2 in. The overall height is 7 ft. 7 in., and the overall length is 11 ft. 1 in., exclusive of the boom. It weighs 21,000 lb., can exert a tractive force of 6,500 lb. and has a turning radius of 6 ft. 6 in.

Discussion of A. A. R. Interchange Rules*

By J. C. Hayes†

We should all benefit by discussion of Interchange Rules and thereby obtain a clearer understanding of just what they contemplate. This paper consists of six subjects for consideration and discussion.

Should the Preparation of Billing Repair Cards in Train Yards and Classification Yards Be Discontinued?

We all know that billing repair cards prepared in train yards and in classification yards cover light run-

* Abstract of a paper presented at a meeting of the Eastern Car Foreman's Association of New York, held in New York City, January 8, 1937.

† Supervisor, A.A.R. Clearing House, New York Central System, Buffalo, N. Y.

ning repairs, such as cotters, brake shoes, shoe keys, nuts, etc. The procedure of preparing these billing repair cards is, in many instances, unnecessary and can be greatly simplified. I feel certain the solution of the problem can be made after an investigation has been completed to develop the facts in order to arrive at proper conclusions.

The average cost per car repaired and per car day for repairs made in train yards and classification yards in certain roads' bills is approximately the same, as shown in Table I.

In fact, all of the charges in the Interchange Rules are based on averages, therefore, it seems fair to assume that it would also be possible to arrive at an average allowance for the very light repairs that are being made in the train yards and classification yards.

Only recently the Interchange Rules were amended to provide charges against car owners for nuts and cotters applied. I am assuming this was done because certain railroads or companies were neglecting these items. But I feel sure that any railroad that might be guilty of such neglect would not be inclined to rectify conditions in this respect simply because their car repair bills might be increased by charges for fifty cotters per month at ten cents per cotter, or $5.

When there is no penalty for neglect some will take a chance, but assess a penalty and then results will be forthcoming. Interchange rules are not prepared on the basis of penalties, but if there is neglect, then a penalty is the only way to overcome it.

Some will say this subject, that is, the discontinuance of billing, has been previously considered, therefore, there is no further action to be taken at this time. The subject should be studied from the viewpoint of discontinuing billing for only such train-yard and classification-yard repairs as I am now advocating.

I realize this same thought would not work out equitably in so far as shop or branch repairs are concerned because some railroads and companies have a regular maintenance program, others medium and others deferred, therefore, for that reason I consider that billing for work performed in shops and on repair branches should be continued.

However, I think the subject is worthy of considerable thought, keeping in mind the severe conditions under which train yard and classification yard billing repair cards are prepared. The discussion, therefore, should be on the idea rather than the method of settlement. The method of settlement can be decided after the necessary facts have been obtained. I estimate that if the idea were found practical it would eliminate the preparation of approximately 6,000,000 billing repair cards per year for bills rendered, or it would eliminate the handling of approximately 12,000,000 such repair cards per year considering both bills rendered and bills received.

Should Handling Line or Car Owner Be Responsible for Cut Journals?

Some contend that slid flat wheels and cut journals should be car owners' responsibility instead of handling line responsibility. Recommendations to that effect have been previously made which were not approved, no doubt, for good and sufficient reasons. If the reasons for not approving such recommendations still hold good today, then a special investigation should be conducted to determine the reason for the wide difference in performance on cars of different ownership. To make this more clear I will make mention of a few comparisons which I understand exist.

In a thirty-day period, Road A found it necessary to change 224 pairs of wheels on Road B cars account of cut journals, whereas in the same period Road B found it necessary to change only 70 pairs on Road A cars on account of cut journals, a difference of 154 pairs in that short period, car days representing a ratio of 1¼ to 1. The average cost to change wheels account of cut journals amounts to approximately $10 per pair. The difference referred to means that Road A lost about $1,540 per month in repairing Road B cars, or a loss of about $18,480 per year.

As a result of such differences I estimate that some railroads are losing approximately $50,000 per year.

Surely there must be a reason for this difference in performance and just what it is, I believe, could be developed through an investigation by those thoroughly acquainted with that phase of car performance. This is the first step that should be taken. The result of such investigation would then permit proper consideration being given as to whether the responsibility for these defects should or should not be changed.

Table I — Average Cost of Making Repairs in Train Yards and Classification Yards

Roads	Percent of train yard repair cards to total repair cards	Average cost per car repaired in train or class. yards	Average cost per car-day for repairs made in train or class. yards
Road A vs. road 1...	55	$0.56	$0.015
Road A vs. road 2...	56	0.54	0.013
Road A vs. road 3...	58	0.52	0.012
Road A vs. road 4...	59	0.46	0.017
Road A vs. road 5...	62	0.60	0.012
Road A vs. road 6...	62	0.54	0.016
Road A vs. road 7...	62	0.50	0.017
Road A vs. road 8...	65	0.46	0.017
Road A vs. road 9...	66	0.67	0.014

Should Cardable Damage Limits Be Revised and Defect Carding for Certain Wrong Repairs Be Discontinued?

I understand that Road T issues, or has issued against it, about 21,000 defect cards per year for cardable damage and wrong repairs, which means about 1,750 defect cards per month.

If that understanding is correct, then an investigation will disclose that too much time is being expended by both shop inspectors and interchange inspectors in preparing defect cards and attaching them to cars and in noting or recording them at interchange points, as the cars pass through interchange, when the time could be better utilized by such employes in making closer inspection for safety.

With reference to the number of defect cards that are issued and not used as authority to bill, about 6,200 or 55 per cent of all defect cards issued per year by or against Road T for Rule 32 damage and wrong repairs on foreign railroad owned cars and private car line cars, excluding owned cars, are not used for billing, the separation being as follows: 1,960 defect cards per year or 32 per cent covering Rule 32 damages are not used for billing and 4,240 defect cards per year or 68 per cent covering wrong repairs not used for billing.

The figures and percentages given in Table II will also tend to convey the thought that the limits for cardable damage are not sufficiently severe.

The question would naturally arise as to what can be done to better existing conditions. There is no question but what many different suggestions would be offered. One thought that could be advanced is to have the extent of damage as the governing factor so that the charges when billed would exceed $10 per defect card. If this were done it would eliminate the necessity of Road T issuing approximately 15,000 defect cards per year,

without considering all of the other railroads. If this suggestion were followed, it is possible that it would eliminate close to 150,000 defect cards per year or 12,500 per month or 400 per day for all railroads in the United States and Canada without causing any hardship to any railroad or company.

Further, it would clear the cars of defect cards and the few defect cards that would be issued for the more extensive damage would not be on the cars for any length of time, as those cars would be damaged to such extent that immediate repairs would be required if the car owner desired such cars to remain in service.

Table II—Extent of Charges Billed on Authority of Defect Cards Issued by or against Road T Covering Rule 32 Damage and Wrong Repairs on Foreign Railroad Cars and Private Line Cars

	Rule 32 damage		Wrong repairs	
	Number defect cards	Per-cent	Number defect cards	Per-cent
Charge less than $1 per card.	480	11	200	12
Charge $1 to $3 per card....	1,100	26	200	44
Charge $3 to $5 per card....	560	13	400	24
Charge $5 to $10 per card...	700	16	260	16
Charge $10 to $50 per card..	920	22	60	4
Charge $50 to $100 per card.	240	6	None	..
Charge $100 or over per card	240	6	None	..
Total	4,240	100	1,660	100

Some will say that the present practice of defect carding should not be discontinued because it will place a hardship on car owner; others may argue that more defect cards should be issued for car owner's protection than are now issued, and others might approve of the elimination of defect cards to a large extent. Therefore, it is anybody's guess as to what should be done and it would be difficult to draw proper conclusions until an investigation has been made to develop the facts.

In the absence of facts, some may contend that damage, regardless of how it occurred, should be considered car owner's responsibility on the basis that the handling line exercised all possible care in handling and they had no control over unusual occurrences. Others may contend that the extent of damage rather than the cause of damage should be the governing factor in the issuance of defect cards and that car owner should be responsible for all rake damage up to the point where the framework of the car is damaged, such as sills, posts, braces and plates, and others may contend that the present limits for unfair usage damage should be increased to such extent that the car would be immediately shopped and thus prevent defect cards from remaining on cars with slight damage until such time as a car owner elects to have repairs made.

Therefore, in view of the large number of defect cards issued covering wrong repairs and minor Rule 32 damage that are not being used for billing, also considering the number of days which elapse between date of defect cards and date of repairs, should a study be made with a view of ascertaining whether it would be practical to greatly reduce the number of such cards issued in order to lessen inspectors' clerical work and thus give them more time to devote to inspection for safety?

Should Correspondence and Investigations Account of Unavoidable Errors Be Reduced?

All billing clerks know of the large amount of correspondence and investigation that result from ordinary errors such as wrong car numbers and errors in pricing repair cards. In the majority of cases where wrong car numbers are involved, investigation discloses a correction in the car number is in order and, therefore, there would be no adjustment. Errors in pricing repair cards are usually due to the large volume of such work performed. In most cases errors in pricing do not total to a large amount, or the amount of over-charges is reduced considerably by the amount of under-charges. Perhaps it would be more economical to all railroads and companies if an arbitrary allowance were made for them, in place of permitting exceptions to be taken to small over-charges or under-charges, or wrong car numbers.

With a view of reducing correspondence and investigations, and believing it would not result in a hardship on any railroad or company, I would offer for discussion the proposition of considering car repair bills correct as rendered when 99.5 per cent correct. In other words, disregard incorrectness due to the extent of one-half of one per cent of the total amount of bill for the unavoidable errors mentioned above.

To explain further, do not permit the billed road to take exceptions to charges unless the net overcharge or net undercharge exceeds one-half of one per cent of the total amount of bill and then only to adjust for an amount in excess of that allowance.

This would mean that when a $1,000 bill was rendered the permissible allowance for all incorrectness would be $5. In the event the net overcharge or undercharge amounted to $12, then an adjustment of only $7 would be in order. I am of the opinion this will reduce exceptions, letters and investigations about 90 per cent. If such a proposition would meet with approval, Rule 91 could be modified accordingly.

Should Car Repair Bills, Both Incoming and Outgoing, Be Analyzed to Prevent the Possibility of Specializing?

Sometimes it would be more advantageous to all concerned if billing clerks were instructed to analyze both incoming and outgoing car repair bills to ascertain whether conditions appear normal in so far as the number of items applied is concerned, instead of utilizing all of their valuable time in checking the billing repair cards and billing statements for correctness of labor and material prices and footings.

At least that is our thought and we have placed that system in effect in our Billing Bureau.

We have been and are now analyzing car repair bills by roads, by stations, by items, and by charges. Needless to say, some very peculiar conditions were noted in both the incoming and outgoing bills. I would not say that "stand-out" cases always represent wrong or improper practices, as investigation in most cases will disclose that the condition which appeared questionable can be explained, but such a check has the effect of letting those involved know that the situation is being watched, and by this method of procedure all foreign railroads and companies will receive the protection to which they are justly entitled.

Table III — Comparison of Repairs Made by Roads A and B

		Item ratio	Car-day ratio
Truck-spring shims	506 to 33	15 to 1	1 to 2½
Box lids	336 to 30	11 to 1	1 to 1
Brake beams	317 to 27	12 to 1	1½ to 1
Air hose	283 to 21	13 to 1	2 to 1
Couplers	145 to 5	29 to 1	1¼ to 1
Knuckles	112 to 1	112 to 1	1 to 1
Brake-shafts repaired	86 to 5	17 to 1	1½ to 1
Truck spring seats	63 to 1	63 to 1	1½ to 1
Knuckle pins	66 to 2	33 to 1	1¼ to 1

As an example, Road A found it necessary in a period of 30 days to apply 1,362 cotters to Road B cars, where-

as in the same period Road B found it necessary to apply only 136 cotters to Road A cars, a difference of 1,226 cotters. Since the number of car days were equal, the car-day ratio is 1 to 1. Other such examples are given in Table III.

Should Rule 9 Be Modified by Reason of Interpretation (1) of Rule 70 Ruling on Charges for Wheel Renewals?

Interpretation (1) of Rule 70 provides that when wrought-steel wheels are applied in place of wrought-steel wheels removed to a car that is not stenciled to show type of wheels standard to it, cast-iron wheels shall be considered as standard to such car and the value of the wrought-steel wheels applied shall not exceed the value of new cast-iron wheels.

Some railroads are taking exception to charges, when wrought-steel wheels are applied in place of wrought-steel wheels removed, contending that car was not stenciled showing wrought-steel wheels standard, although they admit that their cars have mixed wheels under them, and they are requesting adjustment which amounts in some cases to $40 per pair. They further contend that it is necessary for the repairing line to make notation on billing repair cards when car is stenciled for wrought-steel wheels, otherwise the charge will not be accepted when it exceeds the value of new cast-iron wheels.

Investigation disclosed that in some of the cases now in controversy the car was equipped with four pairs of wrought-steel wheels, yet car owner states that fact has no bearing on the permissible charge, as interpretation (1) of Rule 70 is very clear in this respect.

Car owner also has declined to furnish joint evidence in such cases showing whether or not car was stenciled, claiming the Interchange Rules never contemplated that the burden of proof, in such cases, be placed on car owner, and that it is an obligation of the repairing road to make necessary notation on billing repair cards, which, if done, would make the matter clear to all concerned.

Therefore, in view of the complications arising on this phase of car repair billing, should Rule 9 or Interpretation (1) of Rule 70 be modified so it will be clear to all concerned whether car owner must protect the situation through joint evidence, or whether the repairing road must make notation on billing repair card as to the stenciling on car for information of car owner.

Questions and Answers On the AB Brake

Operation of the Equipment

121—*Q.—What ports open in emergency, second stage?* A.—The same as in the first stage, except that the flow of air from the combined auxiliary and emergency reservoirs is restricted to the opening in the delay choke due to the fact that the in-shot valve is now seated.

122—*Q.—What ports open in emergency, third stage?* A.—The same ports are open in this stage, as in the second stage, with the following exceptions: An additional flow of air to the brake cylinder is now obtained via the timing valve and the timing choke. As the quick-action-chamber pressure has been reducing through the vent-piston choke, the vent-valve spring eventually forces the vent valve to its seat, closing communication between the brake pipe and the atmosphere.

123—*Q.—What ports open in release after emergency?* A.—In release after emergency the following ports are open: Brake pipe to the quick-action chamber via the charging choke; brake pipe to accelerated-release check, vent-valve chamber and by-pass checks; auxiliary reservoir to brake cylinder via the in-shot valve; auxiliary reservoir to the release-insuring valve and duplex release-valve check; the quick-action chamber to the accelerated-release piston chamber; the in-shot piston volume to the inshot piston chamber; the emergency reservoir to the duplex release-valve check, spill-over check, and strut diaphragm.

124—*Q.—What ports open in accelerated-emergency release?* A.—In accelerated-emergency release the following ports are open: The brake pipe to the quick-action chamber via the charging choke, and also to the by-pass checks; the combined auxiliary-reservoir and brake-cylinder pressures to the brake pipe via the accelerated-release check valve; the quick-action chamber to the accelerated-release piston chamber; the in-shot-piston volume to the in-shot-piston chamber; the auxiliary reservoir to the release-insuring valve and to the duplex release-valve check; and the emergency reservoir to the spill-over check and the strut diaphragm and to the duplex release-valve check.

125—*Q.—At what stage does either the release or application by-pass check valves function?* A.—The release check valve opens to allow the brake-pipe air to flow to the face of the service piston when releasing, and the application check valve opens to allow the brake-pipe pressure to flow from the face of the service piston when applying the brake, upon the development of approximately 2 lb. difference in pressure across the strainer.

126—*Q.—What would cause this difference in pressure?* A.—The hair strainer becoming clogged with dirt.

127—*Q.—Does the emergency-reservoir pressure vary when the service slide valve assumes release position?* A.—Yes.

128—*Q.—Why?* A.—Communication is established to the auxiliary reservoir.

129—*Q.—What is the advantage of this feature?* A.—It provides a quick recharge of the auxiliary reservoir, and a more prompt and positive release.

130—*Q.—What assurance have we of a positive release in case of excessive friction of the operating parts?* A.—The release-insuring valve functions to accomplish a release.

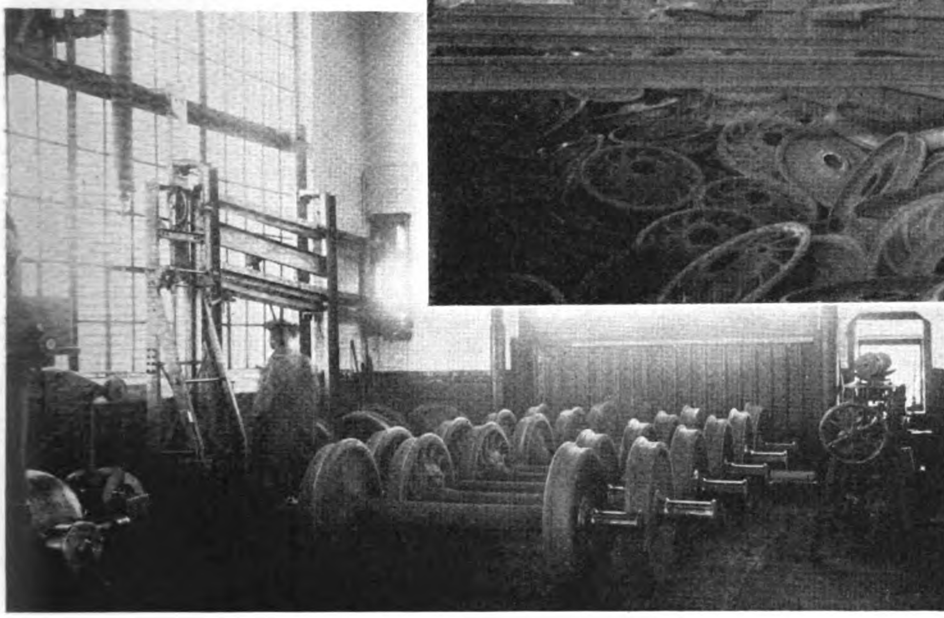
131—*Q.—How is this accomplished?* A.—When the brake-pipe pressure on the left of the release-insuring diaphragm exceeds by 1½ lb. the auxiliary-reservoir pressure on the right, the diaphragm will be deflected to the right, unseating the release-insuring valve. This movement connects the auxiliary-reservoir pressure to the atmosphere via the release-insuring choke, the cavity in service slide valve and the retaining valve.

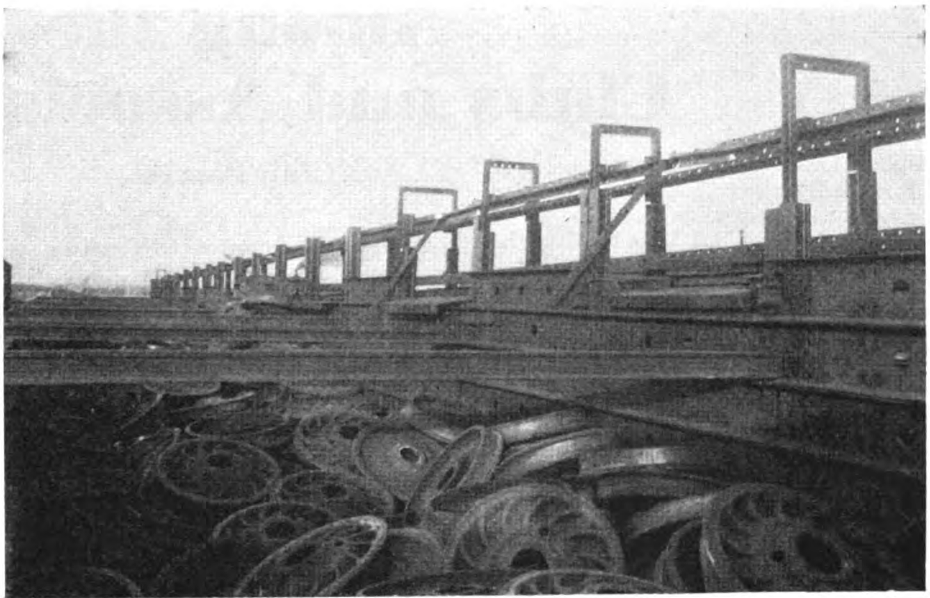
132—*Q.—How long does the reduction of the auxiliary reservoir pressure continue?* A.—Until sufficient differential is created across the service piston to move it and the slide valve to release and charging position.

133—*Q.—How does this prevent excessive reduction of auxiliary-reservoir pressure?* A.—The service slide valve, in moving to release, cuts off communication to the atmosphere.

134—*Q.—With the quick-action chamber uncharged, what provision is made to prevent the emergency slide valve from unseating, in view of the fact that emergency-reservoir pressure is the lower?* A.—The slide valve is balanced by a spring-and-diaphragm-loaded strut. The emergency reservoir is connected to the upper side of the diaphragm, exerting pressure in a downward direction, thereby holding the slide valve on its seat.

Modern wheel shop (below) with inclined runways for moving scrap wheels and axles out of the shop





Inclined runway (above) and short sections of hinged angle used in diverting wheels to the desired scrap bins

Save Labor In Wheel Handling

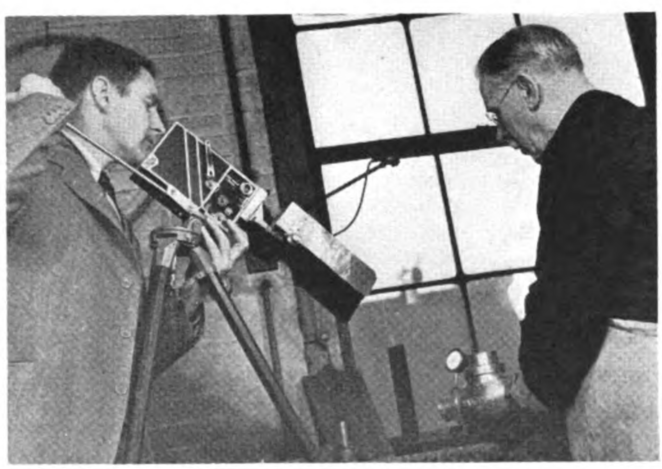
One of the modern wheel shops of the Middle West is that of the Illinois Central at Markham, Ill., where wheel and axle work for the northern lines of this road is handled. One of the features of this shop, which is well equipped with axle lathes, boring mills, a heavy-duty wheel lathe, wheel presses and a Norton car-wheel grinding machine, is the provision for a minimum of manual labor in handling wheels and axles.

Mounted wheels and axles received at this shop from Freeport, Ill., Clinton and the Chicago terminal are unloaded by clam shell from the wheel car to inclined tracks on which the wheels roll into the shop through the door illustrated. Wheels are dismounted in a double-acting press and rolled one at a time to the elevator and inclined runway shown at the left in the lower illustration. Passing through the hole in the shop wall, the wheels roll down the incline shown in the upper illustration, being diverted into the proper scrap bin by a short piece of hinged angle section. These wheels are loaded by means of a magnet from the bin into a scrap car for subsequent sale as scrap.

Axles are placed by means of a monorail hoist on an axle carriage, as shown at the right in the lower illustration. This carriage also operates through the shop wall and down an inclined track, being controlled, however, by an electrically operated endless cable which moves the carriage up and down the runway. A large handwheel is used to trip the carriage opposite the proper pile of stored axles onto which the axle rolls clear. The endless cable then is used to bring the carriage back into the shop, ready for the next axle. All operations of moving the carriage and tripping the axle are controlled by one man from a station at the handwheel shown in the illustration.

Scrap wheels and axles only are sent out of the shop, the others being moved by monorail to designated positions within the shop where necessary conditioning operations are performed to fit the wheels and axles for further service. With this method of handling, 100 pairs of wheels are dismounted and the scrap wheels and axles moved to appropriate scrap piles or bins by three men in eight hours.

* * *



Taking three dimensional colored movies of the making of valves in the factory of the Hancock Valve Division of the Consolidated Ashcroft-Hancock Company—A method incorporating a number of the first experimental stereoscopic industrial shots in full color, made possible by the employment of Polaroid glass, will be on exhibit at the New York Museum of Science and Industry for several months

Among the Clubs and Associations

Purchases and Stores Division, A. A. R.—The Purchases and Stores Division, Association of American Railroads, has selected June 21, 22 and 23 as the dates for its three-day annual meeting to be held at Atlantic City, N. J. Thus the sessions will coincide with the annual meeting of the Mechanical Division, A.A.R., and the exhibit of the Railway Supply Manufacturers Association.

Mechanical Division, A. A. R.—According to a recent circular regarding the annual meeting of the Association of American Railroads, Mechanical Division, which will be held in Atlantic City, N. J., June 16 to 23, inclusive, the reports of committees investigating locomotive matters will be received and discussed Wednesday, Thursday and Friday, June 16 to 18, inclusive, and reports of committees investigating car matters will be received and discussed Monday, Tuesday and Wednesday, June 21 to 23, inclusive.

Canadian Railway Club.—L. W. Wallace, director of the Equipment Research Division of the Association of American Railroads, will be the speaker at the meeting of the Canadian Railway Club at 8:15 p.m. on March 8 at the Windsor Hotel, Montreal.

Southern and Southwestern Railway Club.—John M. Hall, chief inspector Bureau of Locomotive Inspection, Interstate Commerce Commission, will reminisce on twenty-five years of federal inspection of locomotives at the March 18 meeting of the Southern and Southwestern Railway Club, which will be held at 10 a.m. at the Ansley Hotel, Atlanta, Ga.

New England Railroad Club.—The annual meeting, election of officers, etc., of the New England Railroad Club will be held at the Hotel Touraine, Boston, Mass., on March 9, following dinner at 6:30 p.m. Following the business session the construction, etc., of the San Francisco-Oakland Bay bridge will be shown in moving pictures.

Central Railway Club of Buffalo.—"Steel Castings in High-Speed Railroading" will be the subject discussed by William M. Sheehan, manager, eastern district sales, General Steel Castings Corporation, before the meeting of the Central Railway Club of Buffalo at 8 p.m. on March 11 at the Hotel Statler, Buffalo, N. Y.

Western Railway Club.—The March 17 meeting of the Western Railway Club will be Engineering Night. Following dinner at 7 p.m. in the Grand Ballroom of the Hotel LaSalle, Chicago, Dr. Arthur N. Talbot, professor emeritus of the University of Illinois and chairman of the A.R.E.A. Special Committee on Stresses in Railroad Track, will discuss the Relation between Track and Rolling Stock.

Club Papers

Notes on Locomotive Testing with a Glance at History

Railway Club of Pittsburgh.—Meeting held at Pittsburgh, Pa., December 17, 1936. Subject, Notes on Locomotive Testing with a Glance at history, by Lawford H. Fry, Railway Engineer, Edgewater Steel Company. Mr. Fry reviewed early nineteenth century locomotive tests and test procedures and quoted contemporary accounts of first runs made by early locomotives. The later portion of the paper deals mostly with test plants, giving the background of the development of the plants, their location and some of the results obtained from their use. ¶ Mr. Fry stated that the steam locomotive has been the subject of tests for over 100 years but that there is still disagreement over many basic facts which could and should be settled by existing test data. As a matter of background, the paper reviewed the history of George Stephenson's "Rocket." In discussing early American locomotive trials, Mr. Fry mentioned the trial run made by Horatio Allen on August 8, 1829, with the "Stourbridge Lion" at Honesdale, Pa. Another historical locomotive trial was made with the "Best Friend" on the South Carolina Railway in December 1830. This was the first locomotive built in America for actual service on a railroad. Its designer was E. L. Miller of Charleston, South Carolina, who attended the trials on the Liverpool and Manchester Railway the year before. Mr. Fry mentioned "A Practical Treatise on Locomotive Engines," a book published in France in 1834 by Count F. M. G. De Pambour, who conducted a large number of locomotive tests and described them in his book. Pambour made exhaustive practical tests and measured train resistance, studied the evaporative capacity of various locomotive boilers and set up formulas for computing the dimensions of a locomotive for any given service. ¶ Since that day there have been innumerable tests of locomotives on which locomotive design have been based. Mr. Fry did not attempt to give a complete and detailed history of locomotive testing. He pointed out that locomotive tests can be made by one of the following three methods: (1) Road tests with regular trains, (2) road tests at constant speed and cut-off, and (3) tests on a stationary locomotive testing plant. ¶ Discussing the first of these, Mr. Fry stated that road tests with regular trains are useful mainly to check the performance of a given locomotive. They serve to measure coal and water consumption, to examine the relation between train loads and timing, and to check tonnage-rating assignments. Because it is not usually possible with these tests to obtain accurate information regarding such individual processes as combustion, steam production, and utilization of steam, Mr. Fry stated that they did not provide information necessary to make a scientific study of locomotive design. To obtain information for this purpose a locomotive must be run under constant conditions of speed and cut-off for a considerable length of time. These tests can be made on the road under special conditions, or at a locomotive testing plant. ¶ Road tests of this type have been used rather successfully in Russia, France and Germany and are made with an auxiliary locomotive used to pull or brake the test locomotive as needed. Also a further advance mentioned by Mr. Fry in this type of testing includes the use of a dynamometer car and a test train of one or more brake locomotives. Results obtained with this type of test are comparable with those obtained on a stationary plant. ¶ Discussing the locomotive testing plant, Mr. Fry called attention to the first large scale testing plant which was built by the Pennsylvania Railroad and exhibited at the St. Louis exhibition in 1904. He also dealt with the locomotive testing plants designed and erected by Dr. W. F. M. Goss at Purdue University. The first plant was destroyed by fire in 1894. Tests on the second plant threw light on the factors limiting horsepower and rates of combustion which were not well understood before the test-plant results were available. Cylinder action was investigated, and work done on locomotive front-ends influenced American locomotive practice for many years. ¶ The author recalled that the locomotive testing plant set up

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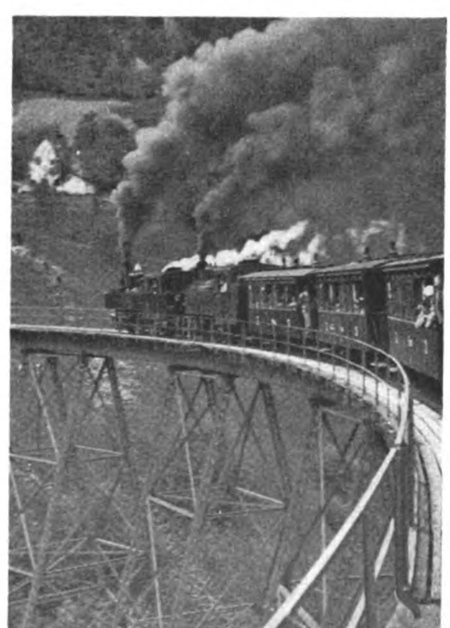


A tourist train on a 30-in gage Austrian railroad which penetrates about 40 miles into the winding valley of the Ybbs river

at the University of Illinois in 1914 was the third to be built in this country. As a matter of historical record Mr. Fry mentioned the early crude plant built in Russia in 1896; the French plant at Vitry, built in 1933, which is used by the seven large railway systems of France, and two small American plants installed by the Chicago & North Western in 1894 and Columbia University in 1899, respectively, both of which were later abandoned. Mr. Fry also mentioned the German plant at Gruenewald, Germany, which was placed in operation in 1930. ¶ Mr. Fry's paper was discussed by Professor L. E. Endsley, who at one time was in charge of the Purdue locomotive testing plant. He discussed the locomotive used at the plant, and researches made with it on front-ends and superheaters. ¶ Mr. Fry closed the discussion by referring to the number of different locomotive designs tried out in Europe.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

Air-Brake Association.—T. L. Burton, care of Westinghouse Air Brake Company, 3400 Empire State Building, New York.

Allied Railway Supply Association.—F. W. Venton, Crane Company, Chicago.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet avenue, Chicago.

American Society of Mechanical Engineers.—C. E. Davies, 29 West Thirty-ninth street, New York.

Railroad Division.—Marion B. Richardson, 21 Hazel avenue, Livingston, N. J.

Machine Shop Practice Division.—G. F. Nordenholt, 330 West Forty-second street, New York.

Materials Handling Division. — F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

Oil and Gas Power Division.—M. J. Reed, 2 West Forty-fifth street, New York.

Fuels Division.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

Association of American Railroads. — J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

Division I. — Operating. — Safety Section.—J. C. Caviston, 30 Vesey street, New York.

Division V.—Mechanical.—V. R. Hawthorne, 59 East Van Buren street, Chicago. 1937 convention, June 16-23, Atlantic City, N. J.

Committee on Research.—E. B. Hall, chairman, care of Chicago & North Western, Chicago.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey street, New York. Annual meeting, June 21, 22 and 23, Atlantic City, N. J.

Division VIII.—Motor Transport.—Car Service Division.—C. A. Buch, Transportation Building, Washington, D. C.

Association of Railway Electrical Engineers. —Jos. A. Andreucetti, C. & N. W., 1519 Daily News Building, 400 West Madison street, Chicago, Ill.

Canadian Railway Club.—C. R. Crook, 2271 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month, except in June, July and August, at Windsor Hotel, Montreal, Que.

Car Department Officers' Association.—A. S. Sternberg, master car builder, Belt Railway of Chicago, 7926 South Morgan street, Chicago.

Car Foremen's Association of Chicago.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

Car Foremen's Association of Omaha, Council Bluffs and South Omaha Interchange.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p. m.

Central Railway Club of Buffalo.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

Eastern Car Foremen's Association. — E. L. Brown, care of the Baltimore & Ohio, St. George, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

Indianapolis Car Inspection Association. — R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

International Railway Fuel Association. — See Railway Fuel and Traveling Engineers' Association.

International Railway General Foremen's Association.—William Hall, 1061 West Wabasha street, Winona, Minn. Next meeting, September 28 and 29, Hotel Sherman, Chicago, Ill.

International Railway Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

Master Boiler Makers' Association.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September, at Hotel Touraine, Boston.

New York Railroad Club.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July, August and September, at 29 West Thirty-ninth street, New York.

Northwest Car Men's Association. — E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, University and Prior avenue, St. Paul.

Pacific Railway Club.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately—June in Los Angeles and October in Sacramento.

Railway Club of Greenville. — J. Howard Waite, 43 Chambers avenue, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

Railway Fire Protection Association.—R. R. Hackett, Baltimore & Ohio, Baltimore, Md.

Railway Fuel and Traveling Engineers' Association.—T. Duff Smith, 1255 Old Colony building, Chicago. Annual meeting, with exhibits, Hotel Sherman, Chicago, September 28, 29, 30.

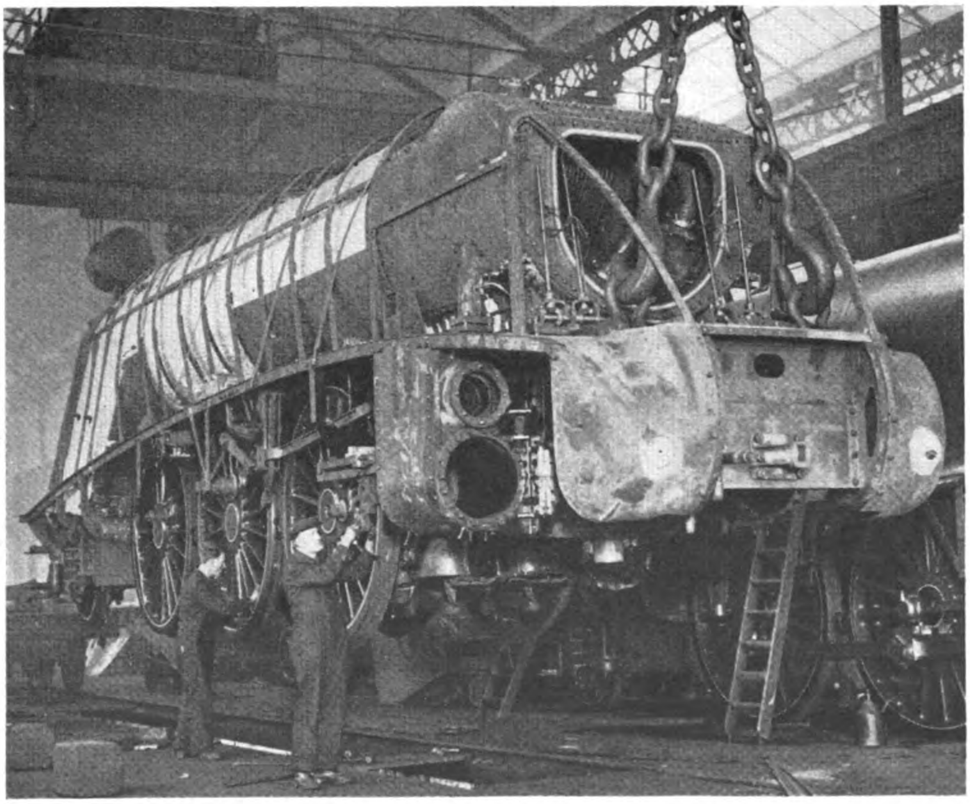
Railway Supply Manufacturers' Association. —J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, Association of American Railroads. Exhibit June 16 to 23, inclusive, Atlantic City, N. J.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

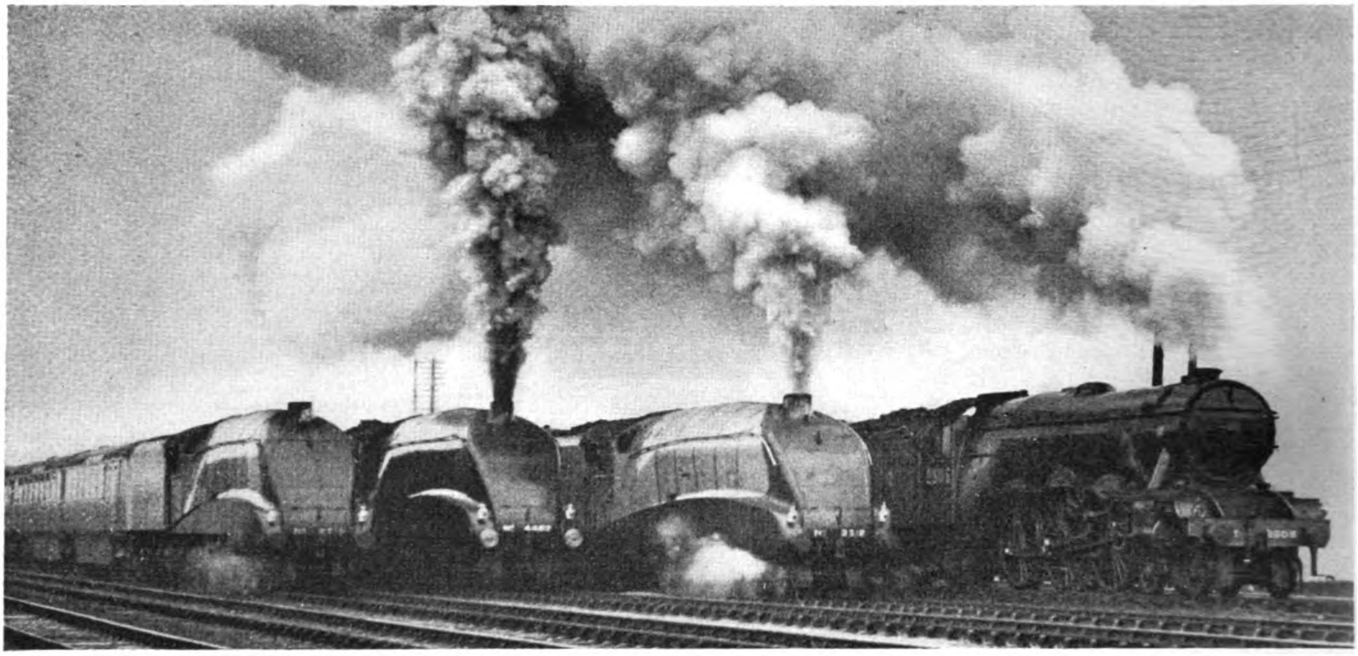
Toronto Railway Club.—R. H. Burgess, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

Traveling Engineers' Association.—See Railway Fuel and Traveling Engineers' Association.

Western Railway Club.—C. L. Emerson, executive secretary, 822 Straus Building, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.



Lifting a streamline locomotive after it had been wheeled at the Dorchester works of the London & North Eastern Railway



The "Golden Eagle," one of the locomotives which are to haul the Coronation express trains of the London & North Eastern between London and Edinburgh, lined up with two Silver Jubilee engines and a Pacific type locomotive during a demonstration

NEWS

Arch-Bar Truck Replacements

In a letter to all freight car owners dated February 6, and pertaining to transportation hazards due to arch-bar truck failures, the secretary of the A. A. R. Mechanical Division included a statement showing the extent of compliance with Interchange Rule 3, Sec. (t), Par. (4), which provides that arch-bar trucks will not be accepted in interchange after January 1, 1938. This statement indicates that on December 31, 1936, 487,203 cars, or 22.2 per cent of railroad and private freight cars, were equipped with arch-bar trucks. The total number of car owners involved is 385 and the total interchange freight equipment owned or controlled, 2,198,365 cars. The report showed that the total number of interchange freight cars equipped with arch-bar trucks expected to be in service as of June 30, 1937, is 387,643.

One of the accompanying tables shows how the percentage of cars with arch-bar trucks has decreased each year from 44.2 per cent in 1929 to 22.2 per cent in 1936. The other table shows the number and percentage of railroad and private cars in interchange service equipped with cast-steel side frames, as compared to arch-bar trucks, as of December 31, 1936.

British Equipment Programs

British railways have authorized the construction during 1937 of 532 locomotives, 2,000 passenger-train cars and 34,000 freight cars. Included in the locomotive total are 17 of streamline design, being constructed by the London & North Eastern to haul its new "Coronation" streamline trains between London and Edinburgh. Names of birds are to be given to these new locomotives, the first five being "Golden Eagle," "Falcon," "Merlin," "Kingfisher" and "Kestrel."

Streamliner Derailed

Two cars of the streamliner "City of Denver" of the Union Pacific-Chicago & North Western were derailed on February 8 when an axle broke near Orchard, Colo. After the accident the train continued to Denver, and, on the following day, made its trip to Chicago without the derailed

(Continued on next left-hand page)

Comparative Yearly Statement of Railroad and Private Freight Cars Equipped with Arch Bar Trucks

	Dec. 31, 1929	Dec. 31, 1930	Dec. 31, 1931	Dec. 31, 1932	Dec. 31, 1933	June 30, 1934	Dec. 31, 1934	June 30, 1935	Dec. 31, 1935	June 30, 1936	Dec. 31 1936
Total number of car owners ...	456	429	425	426	415	415	413	415	401	392	385
Total number of cars	2,823,613	2,835,881	2,757,049	2,677,441	2,545,625	2,485,241	2,410,723	2,352,958	2,281,214	2,226,886	2,198,365
Cars with arch bar trucks	1,248,530	1,156,058	1,065,674	1,000,654	902,357	848,354	782,464	734,799	664,676	589,445	487,203
Percentage with arch bar trucks	44.2	40.8	38.7	37.4	35.4	34.1	32.5	31.2	29.1	26.5	22.2

Recapitulation of Number and Percentage of Railroad and Private Cars in Interchange Service Equipped with Cast Steel Side Frames as Compared to Arch Bar Trucks, as of December 31, 1936

Per cent of cars equipped with side frames	Number, R.R. or P.C.L.	Total cars owned	Cars equipped with side frames		Cars equipped with arch bars		Decrease in AB truck ownership between 6-30-36 and 12-31-36	No. cars with AB trucks expected to be in service as of 6-30-37
			Number cars	Per cent	Number cars	Per cent		
100	65	98,085	98,085	100.0	0	0.0	553	0
75 to 100	122	1,344,913	1,207,589	89.8	137,324	10.2	41,405	100,867
50 to 75	79	455,315	302,811	66.5	152,504	33.5	41,476	108,098
0.1 to 50	87	294,993	102,677	34.8	192,316	65.2	18,465	173,929
0.0	32	5,059	0	0.0	5,059	100.0	343	4,749
Totals	385	2,198,365	1,711,162	77.8	487,203	22.2	102,242	387,643

cars, an observation car and a sleeping car. At Chicago the newly constructed cars of the Pullman Company, the "Advance" and the "Forward," were added to the consist of the "City of Denver" and were used until a new axle had been placed in the truck of the derailed cars on February 10.

P. R. R. Program for Eliminating Arch-Bar Trucks

THE Pennsylvania's program for installing cast-steel side frames on its freight cars which are now equipped with arch-bar trucks is proceeding at a rate which will assure its completion by the end of this year. Thus, the Pennsylvania will have no freight cars equipped with arch-bar trucks on January 1, 1938, the date on which the Association of America Railroads' rule barring such cars from interchange becomes effective. The Pennsylvania's program involves the replacement of trucks under 185,000 cars.

Reverse-Gear Order Proposed to I. C. C.

THE principal railroads and the brotherhoods representing their engine employees reached an agreement on November 20 on a plan for the equipment of locomotives with power reverse gears. This contemplated the dismissal of the complaint which had been filed by the brotherhoods with the Interstate Commerce Commission, but W. P. Bartel, director of the commission's Bureau of Service, and H. C. King, special examiner, have recommended in a proposed report that the commission retain control of the subject by issuing an order requiring the roads to equip their lever-operated manual-reverse-gear-type locomotives of the classes and weights specified in the agreement (road engines weighing 150,000 lb. or more on drivers and switching engines weighing 130,000 lb. or more on drivers) with a suitable type of power-operated reverse gear.

The report says that as of August 1, 1935, it was shown that 27,587, or 58 per cent, of the locomotives owned by the Class I railroads were equipped with power reverse gear but that "we have no means of determining the total cost to the railroads of equipping the locomotives not now operated with power reverse gear with that device." The railroads had given an estimate of $4,630,165 for 11,247 locomotives at $411.68 per locomotive, while the complainants had given an estimate of $2,643,045 for a cheaper type of gear.

In enjoining the previous order, held invalid because of the absence of the basic or essential findings as to whether the use of manual reverse gear as compared with power reverse gear "causes unnecessary peril to life or limb," the district court had found that the commission had failed to consider evidence as to the railroads' financial condition, so the proposed report considers it and reaches the conclusion that "no undue burden should be imposed on any railroad but that the record clearly indicates the desirability of equipping most of the locomotives operating under present-day conditions with modern reversing gear. In the long run power reverse gear is economical."

(*Turn to next left-hand page*)

New Equipment Orders and Inquiries Announced Since the Closing of the February Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Can. Pac.	30[1]	4-6-4	Montreal Loco Wks.
	20	F-1-a	Canadian Loco. Co.
C. & N. W.	8[2]	4-6-4	American Loco Co.
E. J. & E.	6	Diesel-elec.	Electro-Motive Corp.
Mich. Limestone Co.	2	600-hp. Diesel switchers	American Loco Co.
Pere Marquette	15	2-8-4	Lima Loco. Wks.
	11	Tenders[3]	American Loco. Co.
Pickands, Mather & Co	1	0-8-0	Baldwin Loco. Wks.
Santa Barbara-Vigia (Venezuela)	1	2-4-4 tank	Baldwin Loco. Wks.

LOCOMOTIVE INQUIRIES

Roberval & Saguenay	1	2-8-2	....

FREIGHT CAR ORDERS

Road	No. of cars	Type of cars	Builder
Can. Nat'l	1,000	Box	
	300	Gondola	Eastern Car Co., Ltd.
	175	Refrigerator	
	15	Snow plows	
	1,000	Box	National Steel Car Corp.
	1,000	Box	Canadian Car & Fdry. Co.
	58	Flat	
	125	Refrigerator	Co. shops at Transcona, Man.
Can. Pac.	1,900	40-ton box	Canadian Car & Fdry Co.
	1,100	40-ton box	
	300	50-ton hopper	National Steel Car Corp.
	200	50-ton gondola	
	100	75-ton gondola	
Clinchfield	600	50-ton hopper	American Car & Fdry. Co.
	250	50-ton gondola	
	250	50-ton box	Greenville Steel Car Co.
C. & I. M.	100	Hopper	Pullman-Std. Car Mfg. Co.
	100	Gondola	
C. & N. W.	150	50-ton Rodger ballast	American Car & Fdry. Co.
Great Nor.	500	Box	American Car & Fdry. Co.
	500	Box	Pullman-Std. Car Mfg. Co.
	500	Gondolas	Pressed Steel Car Co.
Lehigh Valley	20	Caboose	Company shops
Louisville & Nashville	300	Maxend Hart Selective ballast	
	27	50-ton Hart Selective ballast	American Car & Fdry. Co.
	500	Hopper	
	500	Hopper	Bethlehem Steel Co.
	500	Hopper	Mt. Vernon Car Mfg. Co.
	400	Hopper	Pressed Steel Car Co.
	800	Hopper	Pullman-Std. Car Mfg. Co.
Louisiana & Arkansas	100	Box	Pullman-Std. Car Mfg. Co.
M-K-T	500	Gondolas	Company shops
	500	Stock	
	100	40-ton auto.	
	125	50-ton auto.	American Car & Fdry. Co.
	25[4]	50-ton auto.	
Mo. Pac.	500	55-ton twin hopper	American Car & Fdry. Co.
	1,000	50-ton box	Mt. Vernon Car Mfg. Co.
	700	50-ton gondolas	Pressed Steel Car Co.
	25	Caboose	Magor Car Corp.
	300	50-ton flat	Company shops
Mexican Ry.	50	Box	Pressed Steel Car Co.
N. C. & St. L.	500	Box	Pullman-Std. Car Mfg. Co.
Phelps Dodge Corp.	30	30 cu. yd. dump	Differential Steel Car Co.

FREIGHT-CAR INQUIRIES

Central of Brazil	350	55-ton Gondola	....
	150	55-ton box	....
	250	28-ton gondola	....
	150	20-ton box	....
	100	Flat	....
D. T. & I.	500	50-ton box	....
	200	50-ton auto.	....
	100	50-ton auto. with racks	....
Grand Trunk Western	200	40-ton refrigerator	....
	200	50-ton auto.	....
Newburgh & South Shore	100	50-ton gondolas	....

PASSENGER-CAR ORDERS

Road	Type of car	No. of cars	Builder
C. & O.	3	Comb. pass. & bagg.	Bethlehem Steel Co.
C. B. & Q.	4[5]	Coaches	Edward G. Budd Mfg. Co.
	2[5]	Coach-dinette	
Ill. Central	20	40-ton bagg-exp.	American Car & Fdry. Co.
M-K-T	25	Chair	
	3	Dining	American Car & Fdry. Co.
	1	Lounge	
Sou. Pac.	41[6]	Pass.	Pullman-Std. Car Mfg. Co.

PASSENGER-CAR INQUIRIES

Erie	80	Milk	....

[1] These locomotives will have 275-lb. boiler pressure, and 45,000-lb. tractive force; five of the locomotives will be equipped with boosters.

[2] Purchase authorized by district court at Chicago. The locomotives are to be designed to haul 14 to 16 cars of standard weight at 120 m.p.h. Two will be used on the "400" between Chicago and the Twin Cities, and six on through trains between Chicago and Omaha.

[3] Each tender will have a capacity of 22 tons of coal and 22,000 gallons of water.

[4] To be equipped with end doors.

[5] The 4 coaches will be used with conventional equipment operated on the "Fort Worth & Denver City" between Denver, Colo., Fort Worth, Tex., and Dallas. The 2 coach-dinette cars will be used in the "Twin Cities Zephyrs."

[6] These cars are in addition to the 24 ordered last year for use in the new Daylight trains. Of the 41 cars, 25 are for general service and 16 are for the Sunbeam of the Texas & New Orleans.

Type AB Brake Installations

Under date of January 30, 1937, the secretary of the Mechanical Division, A. A. R., issued to all car owners the usual fourth quarterly statement showing the number of freight cars on which brake equipment has been converted to comply with the specifications for freight car air brakes, adopted in 1933. One of the tables indicates that 109,796 railroad and private cars were equipped with Type AB brakes as of December 31, 1936, this being 4.99 per cent of all interchange freight cars. The other table shows how this percentage has increased each quarter since March 31, 1935, when it was 1.18 per cent.

Railroad Private Cars Equipped with Type AB Air Brakes—Report for Quarter Ending December 31, 1936

Number of car owners	401
Number of interchange freight cars owned as of December 31, 1936	2,200,303
Number of new interchange freight cars acquired during the quarter	19,472
Number of interchange freight cars converted during the quarter	3,676
Number of cars equipped with AB brakes as of September 30, 1936	86,762
Number of cars equipped with AB brakes as of December 31, 1936	109,796
Number of units retired, destroyed or otherwise disposed of during the quarter	37,175
Percentage of interchange freight cars equipped with AB brakes as of December 31, 1936.	4.99

Comparative Quarterly Statement of Railroad and Private Cars Equipped with Type AB Air Brakes

	Mar. 31, 1935	June 30, 1935	Sept. 30, 1935	Dec. 31, 1935	Mar. 31, 1936	June 30, 1936	Sept. 30, 1936	Dec. 31, 1936
Total car owners	351	394	422	420	416	416	411	401
Int. frt. cars owned..	2,337,716	2,338,480	2,330,021	2,283,681	2,242,691	2,230,506	2,219,775	2,200,303
Cars with AB brakes.	27.571	31,546	35,920	46,842	53,499	66,361	86,763	109,796
Per cent with AB brakes	1.18	1.35	1.54	2.05	2.39	2.98	3.91	4.99

Supply Trade Notes

The Pressed Steel Car Company, Inc., has moved its New York office from 80 Broad street to 230 Park avenue.

R. D. Bartlett, assistant to the president of the Chicago Railway Equipment Company, Chicago, has been promoted to vice-president in charge of manufacture.

The Westinghouse Electric & Manufacturing Company, about May 1, will move its Pittsburgh, Pa., office and some of its general offices now located at East Pittsburgh, to the Union National Bank building in Pittsburgh.

Cleon M. Hannaford, who has been appointed sales engineer, western territory, of the Wine Railway Appliance Company, as noted in the January 9 issue of the Railway Age, page 133, was born in Marlboro, N. H., on March 6, 1891. In 1913

Cleon M. Hannaford

he became a blue-print operator in the employ of the Boston & Albany, later serving as tracer and then draftsman in the mechanical department. On January 1, 1917, he became a draftsman in the mechanical department of the Chesapeake & Ohio at Richmond, Va., resigning in 1922 to enter the railway supply business as president of the Car Devices Company, Inc., at Richmond. Mr. Hannaford is now sales engineer, western territory, of the Wine Railway Appliance Company and the Unitcast Company, with headquarters at Toledo, Ohio.

Muscoe Burnett, Jr., assistant sales manager of The Oxweld Railroad Service Company, Chicago, has been appointed sales manager. Mr. Burnett was born at Paducah, Ky., and was educated at the

Muscoe Burnett, Jr.

University of Virginia. Since leaving college in 1920, he has been associated continuously with various units of the Union Carbide & Carbon Corporation, of which The Oxweld Railroad Service Company is one. His first connection in 1920 was with The Oxweld Acetylene Company. Four years later he was transferred to the export department of the Union Carbide Company, later going to the Linde Air Products Company as assistant division manager at Chicago. He held the latter position until October, 1935, when he was appointed assistant sales manager of The Oxweld Railroad Service Company.

Daniel J. Saunders has been appointed manager of railway and industrial sales of the Permutit Company with headquarters at its main office in New York City.

G. O. Hauskins has entered the employ of the Peerless Equipment Company, assigned to the sales department, in its New York office. Mr. Hauskins was formerly with the Mt. Vernon Car Mfg. Co.

Obituary

Henry E. Sheldon, president and founder of the Allegheny Steel Company, Brackenbridge, Pa., died at his home in Pittsburgh, Pa., on February 10, at the age of 75 years. In 1932, Mr. Sheldon announced a new metallurgical development permitting ordinary carbon steel to be clad with stainless steel.

Edward M. Sexton, railroad sales manager of Air Reduction Sales Company, died on February 15, in New York, after an illness of several weeks. He was 56 years old. Mr. Sexton was born on Staten Island, N. Y., and was educated in the public schools there. Previous to his connection with Air Reduction, he was in the sales department of Holt & Co., flour merchants, and the Western Electric Company, which he represented in Chicago and Denver, Colo. He began his career with Air Reduction as a salesman in the New York metropolitan district in 1916. Later he was appointed manager of the Chicago district,

Edward M. Sexton

and from this position was transferred back to New York as manager of the metropolitan district. When in 1922 the Davis-Bournonville Company's personnel was merged with that of Air Reduction, he was selected to manage the railroad sales department at New York.

(*Turn to next left-hand page*)

Personal Mention

General

A. C. Melanson, who has been appointed superintendent of motive power and car equipment of the Quebec district of the Canadian National, with headquarters at Quebec, Que., as noted in the February issue of the *Railway Mechanical Engineer,* entered railway service in April, 1911, at Moncton, N. B., as a machinist apprentice. Subsequently he was appointed tracer and then draftsman. In May, 1919, he was transferred in the latter capacity to Toronto, Ont., and in January, 1922, became material inspector. He was transferred as material inspector to Montreal, Que., in July of the following year and a year later to Stratford, Ont. In April, 1924, he was appointed superintendent of the St. Malo shops at Quebec.

A. C. Melanson

George S. West, superintendent of the Pittsburgh division of the Pennsylvania, has been appointed general superintendent of the Southwestern division, with headquarters at Indianapolis, Ind. Mr. West was born at Altoona, Pa., on June 23, 1893, and was graduated from Pennsylvania State College in 1917, with the degree of Bachelor of Science, Railroad Mechanical Engineering. He entered the service of the Pennsylvania on June 14, 1909, as a laborer on the Buffalo division, working in this capacity during the summers of 1909, 1910 and 1911. After entering the service permanently in 1912, he served successively as helper, car repairman, blacksmith helper, draftsman, and machinist, and on April 16, 1920, he became motive-power inspector. On November 1 of the same year he was appointed assistant road foreman of engines at Philadelphia and on February 15, 1923, became assistant master mechanic at New York. On November 1 of that year he was appointed assistant engineer of motive power of the Central Pennsylvania division and on June 16, 1929, became master mechanic at Buffalo, being transferred to the Philadelphia Terminal division on March 1, 1930. Mr. West was appointed superintendent of the Monongahela division on November 1, 1931; superintendent of the Erie and Ashtabula division on September 16, 1932; superintendent of the Maryland division on July 1, 1933, and superintendent of the Pittsburgh division on April 1, 1935.

George S. West

Master Mechanics and Road Foremen

D. M. Smith, division master of the Canadian Pacific at Edmonton, Alta., has been transferred to Winnipeg, Man., to succeed G. Moth, division master mechanic at that point, who has retired.

J. W. McKinnon, division master mechanic of the Canadian Pacific at Calgary, Alta., has been transferred to Edmonton, Alta., to succeed D. M. Smith as division master mechanic at that point.

W. D. Dickie, general foreman, motive power and car department, of the Canadian Pacific, at Moose Jaw, Sask., has been appointed division master mechanic, with headquarters at Calgary, Alta., to succeed J. W. McKinnon.

Car Department

W. A. Holcomb, gang leader in the car department of the Norfolk & Western at Bluefield, W. Va., has become gang foreman, succeeding Frank Spencer, deceased.

Shop and Enginehouse

J. H. Evans, a blacksmith in the shops of the Norfolk & Western at Roanoke, Va., has become assistant foreman, succeeding C. E. Pond.

H. J. Sauter, assistant foreman in the machine shop of the Norfolk & Western at Portsmouth, Ohio, has become assistant machine-shop foreman, succeeding J. G. Smith.

J. G. Smith, assistant machine-shop foreman of the Norfolk & Western at Portsmouth, Ohio, has been promoted to the position of machine-shop foreman, succeeding J. H. Hahn.

J. H. Hahn, machine-shop foreman of the Norfolk & Western at Portsmouth, Ohio, has become back-shop foreman at Portsmouth, succeeding E. C. Goetz, deceased.

C. E. Pond, assistant foreman at the Roanoke, Va., shops of the Norfolk & Western, has become assistant blacksmith shop foreman, succeeding W. H. Noell, retired.

G. S. DeArmond, a machinist in the shops of the Norfolk & Western at Portsmouth, Ohio, has become assistant foreman in the machine shop, succeeding H. J. Sauter.

Purchasing and Stores

C. F. McNeal, local storekeeper of the Northern Pacific at Auburn, Wash., has been appointed division storekeeper at Glendive, Mont., to succeed R. G. Becker.

R. G. Becker, division storekeeper of the Northern Pacific at Glendive, Mont., has been appointed district storekeeper at the Como store, St. Paul, Minn., to succeed A. C. Johnson.

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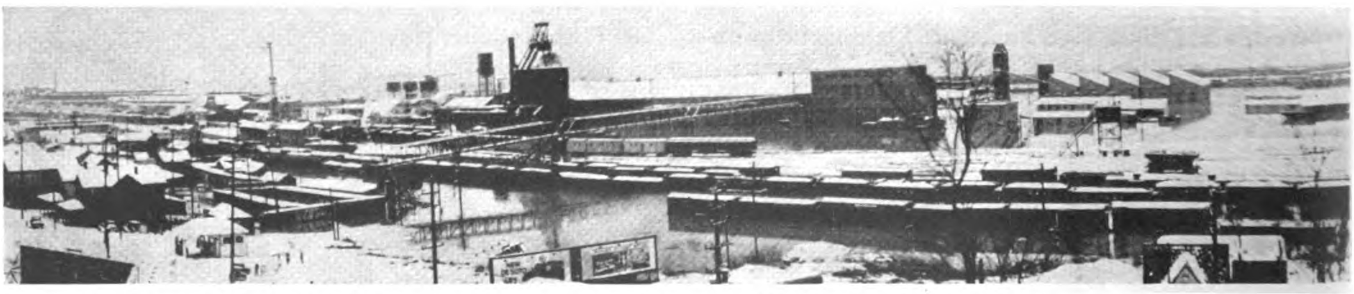
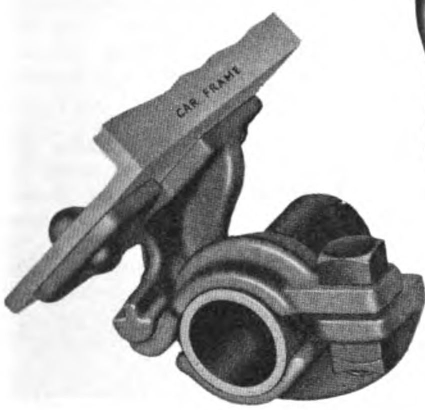
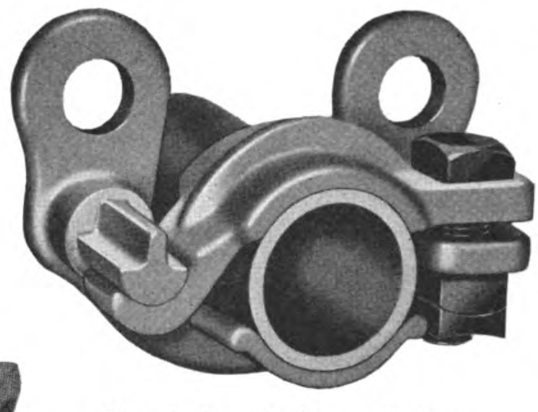


The yard and shops of the Norfolk & Western at Portsmouth, Ohio, when the Ohio River was at the 68-ft. stage—It later rose to about 75 ft.

T-Z Car Specialties

Type 4 clamp for hopper car side application.





Type 3 clamp for box and other types of cars.

Air brake retaining valve bracket.

T-Z Pipe Clamps

The long bearing surface prevents breakage and pipe wear as well as longitudinal movement and pipe vibration. The firmly clamped piping prevents connection failures which minimizes leaking air lines resulting in more efficient operation of the air brake system.

The clamps eliminate the use of angle irons, U bolts and nuts, and are economically applied and maintained. They are efficient and inexpensive.

T-Z Patented Safety Tread Brake Step

Raised and depressed nibs produced by a modern method of punching the tread provides a special drainage feature and assures secure footing in any direction under all weather conditions. No metal is cut away which makes the T-Z tread much stronger than the ordinary steel brake step.

The steps are made, as requested, from No. 10 U. S. S. gage open-hearth or copper-bearing steel. They can be applied to all types of freight cars in accordance to A.A.R. specifications.

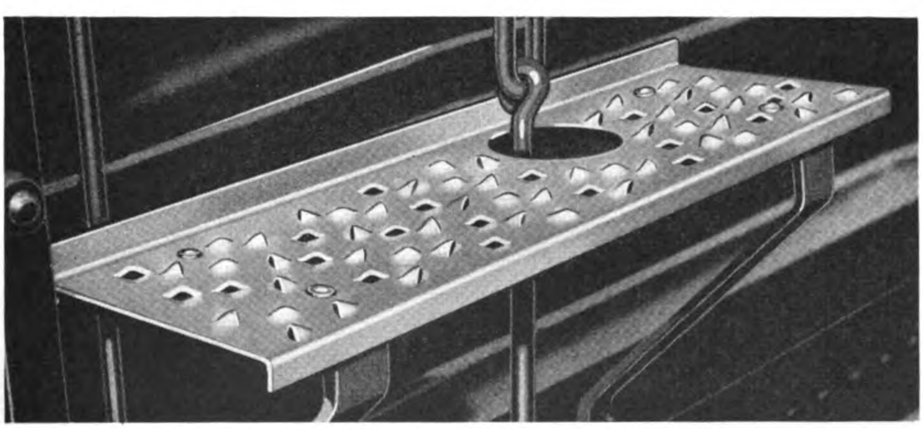
Retaining Valve Bracket

It can be permanently attached to any type of car end with either rivets or bolts. The retaining valve may be applied or removed from the outside of the car.

The slots eliminate the necessity for accuracy in cutting to length the connecting pipe.

It is a time and money saver should any trouble occur with either the retaining valve or pipe leading to it.

T-Z brake step applied to a car.



T. Z. RAILWAY EQUIPMENT CO., Inc.

310 S. MICHIGAN AVENUE **CHICAGO, ILL.**

DAVID McK. FORD, assistant to the vice-president, purchases and stores, Canadian National, has been appointed general purchasing agent for the system. Mr. Ford was born in Glasgow, Scotland, and first entered railway service with the North British Railway in 1900 as a clerk in the general goods manager's office. Three years later he became associated with the Caledonian Railway as a clerk in the district superintendent's office. In April, 1905, he went to Canada and entered the employ of the Canadian Northern at Toronto, as a clerk, but in July of the same year he left to accept a position as chief clerk in the operating and accounting department of the Halifax & Yarmouth at Yarmouth, N. S. In December, 1905, he went to the Halifax & South Western as chief clerk in the auditing and accounting department, with headquarters at Bridgewater, N. S. In July, 1910, he returned to the Canadian Northern Express Company as auditor and cashier at Quebec and in February, 1916, was appointed auditor, Quebec lines of the Canadian Northern. Mr. Ford was appointed accountant, eastern lands department of the Canadian National, in September, 1916, and in November, 1918, became chief clerk in the president's office, C. N. R. and Canadian Government Merchant Marine, which position he held until 1922, when he was appointed office assistant to the president. Upon the formation of the present Canadian National in 1923, Mr. Ford became assistant to the director of purchases and supplies and in 1924 assistant to vice-president of purchases and stores.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

INDUSTRIAL PACKINGS. — The United States Rubber Products, Inc., 1790 Broadway, New York, has issued a 112-page manual on the subject of industrial packings for use by engineers and executives in the railway, automotive, marine and aviation fields.

WELDING.—"The Welding of Wrought Iron" is the title of the service bulletin issued by the A. M. Byers Company, Pittsburgh, Pa.

RIVETING ALUMINUM.—The Aluminum Company of America, Pittsburgh, Pa., has issued a revised copy of its booklet on The Riveting of Aluminum and Its Alloys. The booklet contains 36 pages.

METALAYER.—"Railroad uses for MetaLayeR" is the subject of the pocket size, six-page folder No. 1207 issued by the Metals Coating Company of America, 495 North Third street, Philadelphia, Pa.

PROTECTIVE COATING. — The Dampney Company of America, 1243 River Road, Hyde Park, Boston, Mass., has revised its eight-page bulletin describing a protective coating for locomotive, steamship and stationary boilers.

BOLT HEADING AND FORGING MACHINES. —Bulletin 64 of the Ajax Manufacturing Company, Cleveland, Ohio, is devoted to an illustrated description of Air-Clutch operated bolt-heading and forging machines and their construction.

METAL PAINT.—"Koppax, Black Paint," issued by the Koppers Products Company, Pittsburgh, Pa., contains instructions for the painting of metal surfaces of many kinds, including locomotive front ends and fireboxes and railroad bridges. Koppax is a water-resistant, heat-resistant and corrosion-resistant material.

PIPE REPAIR CLAMPS.—Under the title "Repair Clamps and Saddles for Steel and Cast-Iron Pipes" the M. B. Skinner Company, South Bend, Ind., has issued catalog No. 36 containing illustrations and information regarding the methods of repairing pipe-line leaks in shop, terminal or power-plant air lines, fuel lines, high-pressure steam lines, etc.

GISHOLT STANDARD TOOLS.—The Gisholt Machine Co., Madison, Wis., illustrates an extensive line of standard tools and holding devices in its 38-page catalog. These tools are adapted to a wide range of work on No. 3, 4 and 5 ram type universal turret lathes and on other types of Gisholt turret lathes.

CONTOUR SAVING.—A treatise on a process of metal cutting, known as Contour Sawing, has been issued by Continental Machine Specialties, 1301 Washington avenue, South, Minneapolis, Minn. The book gives a history of band sawing and band filing and discusses the saws and operating technique for this field.

GRILLES AND REGISTERS.—Catalog 37T of the Hart & Cooley Manufacturing Co., 61 W. Kinzie street, Chicago, is devoted to a line of H & C grilles and registers developed especially for use in the air conditioning of railroad equipment. All drawings are listed in numerical sequence, with a footnote at the bottom of each giving information regarding the application of the item.

THE SUPERHEATER.—A series of discussions on the superheater as a factor in locomotive design is being issued by The Superheater Company, 60 East Forty-Second street, New York, in the form of a bulletin entitled "More Power to You." The bulletin consists of a series of Railway Age advertisements which briefly present the advantages of high superheated steam temperatures.

WELDING WIRE AND EQUIPMENT.—An attractive loose-leaf binder, issued by the Hollup Corporation, Chicago, describes Flexarc welding machines, Hollup accessories, and various Sureweld coated rods used for welding operations in general industry, as well as by the railroads in the construction of light-weight streamline cars, welded hopper cars, etc. The latest specifications of the American Welding Society as regards materials and physical tests are quoted, also S.A.E. specifications for various types of steels.

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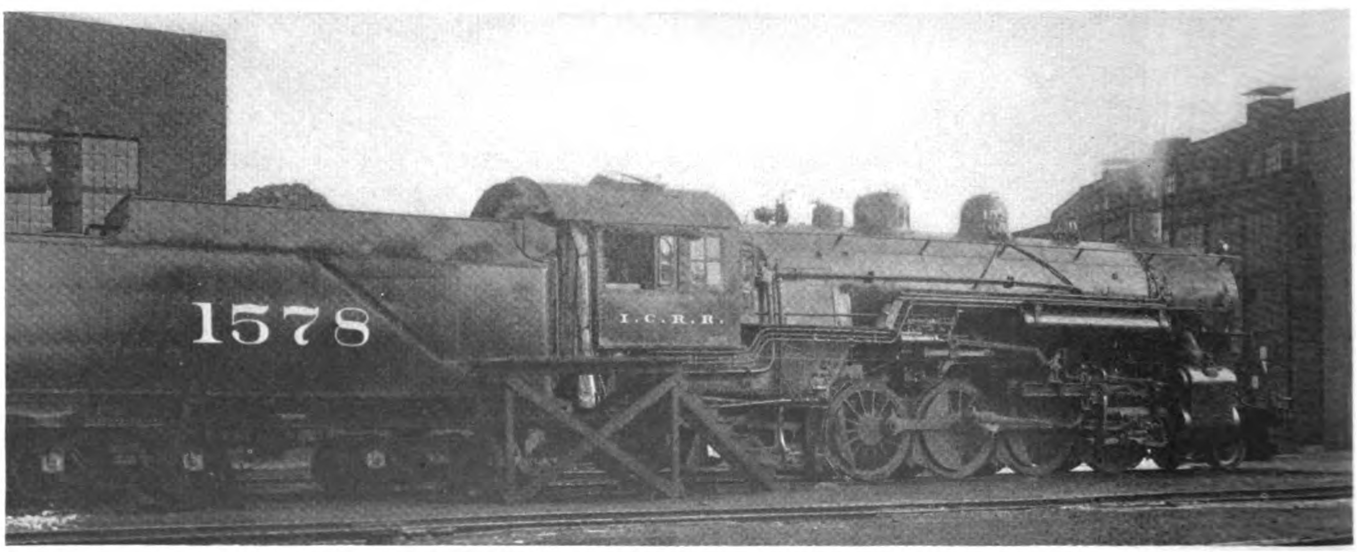

Illinois Central Mikado-type locomotive at modern equipped enginehouse, Markham, Ill.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal
With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

April, 1937

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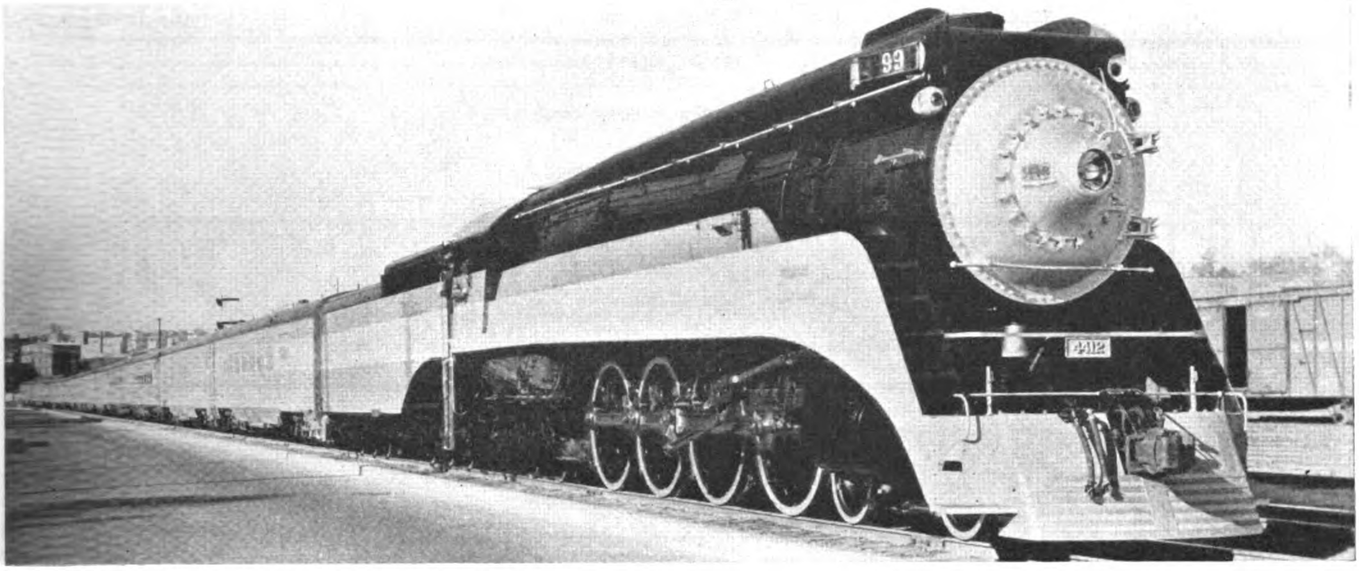
RAILWAY
MECHANICAL ENGINEER



One of the Southern Pacific "Daylight" streamliners at Los Angeles, Calif.

Pacific Coast Streamliners

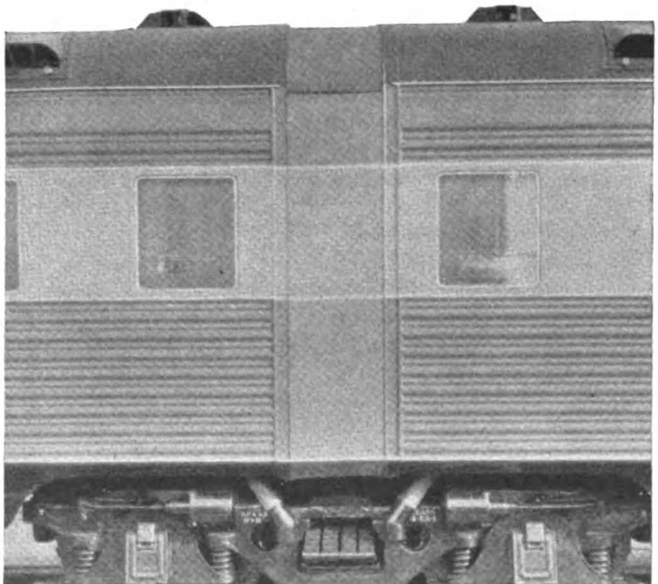
Southern Pacific gets complete new equipment for the Daylight. Cars of light-weight construction built by Pullman-Standard

THE Southern Pacific has recently placed in service two new 12-car trains, built by the Pullman-Standard Car Manufacturing Company, Chicago, and comprising complete new car equipment* for the well-known "Daylight" trains which operate between San Francisco, Cal., and Los Angeles. The consist of each of the trains is identical, as given in the table, and includes one baggage-coach, seating 44; one full coach, seating 48; six coaches, articulated in units of two, seating 50 passengers per car; a tavern car, seating 42; a diner, seating 40; a parlor car, seating 33; and a parlor-observation car, seating 41; or a total seating capacity of 548. The 12 cars have a coupled length of slightly over 870 ft. and a light weight of 1,144,340 lb., or fully one-third less than conventional riveted steel cars. The weight of each train, including the locomotive, ready for service, is 2,028,551 lb.; and each train cost approximately $1,000,000.

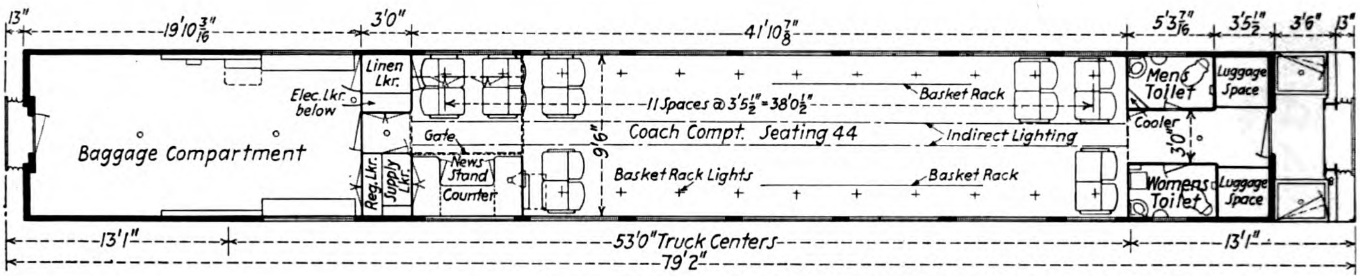
The inside width of the cars is 5¼ in. greater than that of conventional equipment. Although the total height of the cars has been decreased 6 in., thus lowering the center of gravity 9½ in., the new cars provide full standard headroom from floor to ceiling. The lower center of gravity is designed to provide greater safety and riding comfort at high speeds.

The strength members and roof sheets are made of Cor-Ten steel, having an ultimate tensile strength of 75,000 lb. per sq. in. The entire framing of each car is assembled by welding. Sheathing is of light-weight stainless steel having an ultimate tensile strength of 110,000 lb. per sq. in. Aluminum is also used ex-

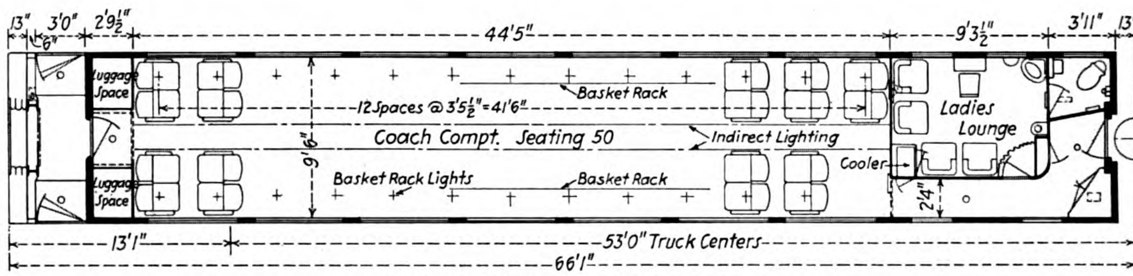
* New streamline steam locomotives, built by the Lima Locomotive Works, Inc., and designed to haul these trains in modern high-speed service, were described in detail in the March *Railway Mechanical Engineer.*



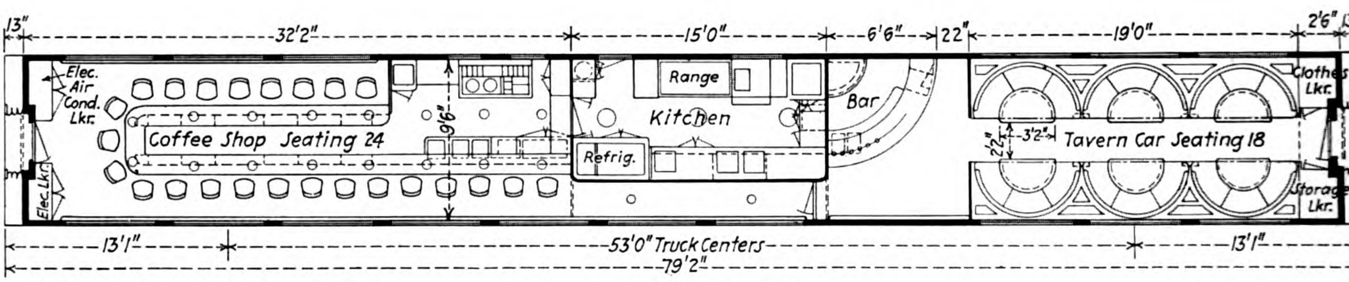
Articulated connection at one of the intermediate trucks



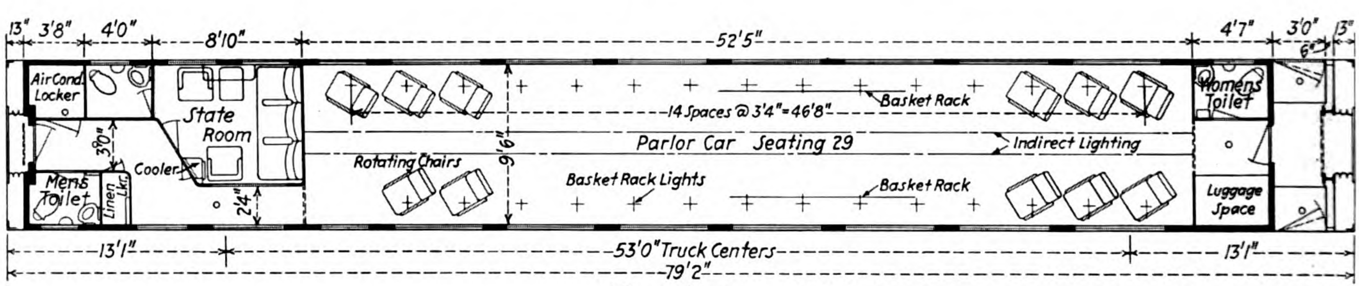
The combination baggage-coach



Articulated body unit with ladies' lounge



The coffee shop and tavern car



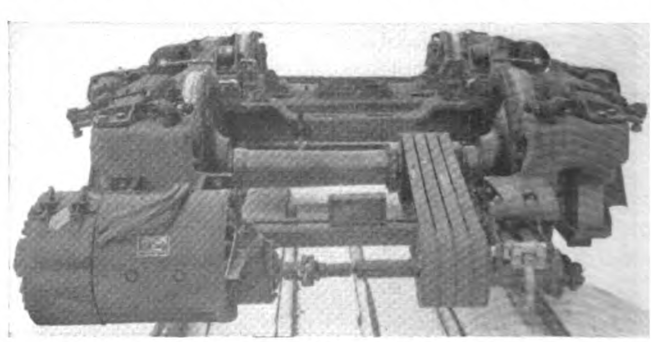
The parlor car

tensively for interior trim and decorative purposes. The walls and roof are insulated with a special light-weight material, and floor insulation is of pressed cork. The inside finish is pressed wood, and Plymetl is used in all doors and partitions.

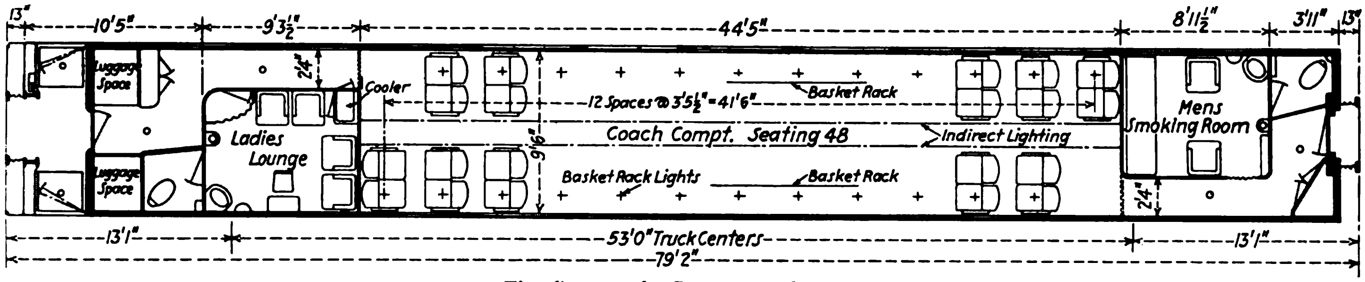
The exterior color scheme provides a wide orange, red and black striping which sweeps the entire length of the train, including the locomotive, and emphasizes the sleekness and streamlining. The roof and lower skirting are black; the letter board below the roof line is red; the section from the letter board to the window sills is orange; and the section from the window sills down to the top of the skirting is red. Horizontal trim moldings above and below the windows are finished in aluminum bronze.

The interior color scheme consists of individual cars harmoniously styled in striking combinations of cream, Nantes blue, light tan, brown, coral, orange, terra cotta, smoke gray, jade green, ivory, henna, apricot, yellow and rust. Moldings have a satin-aluminum finish. Seat covering textures are varied in harmony with the color schemes of the cars.

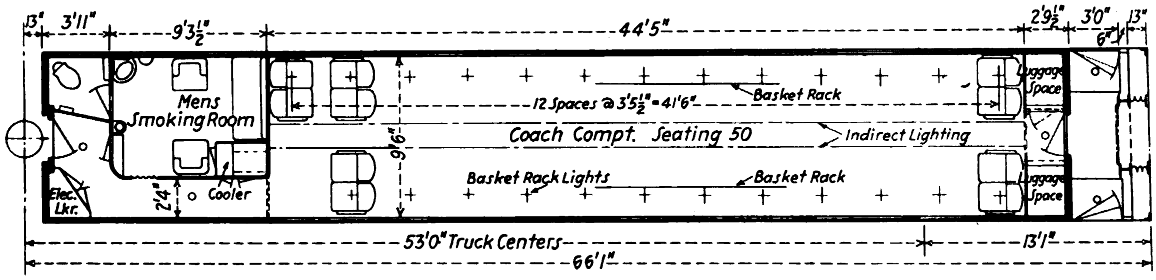
Streamlining is complete throughout the train, including the specially streamlined locomotive. The elimination of practically all rivet heads by means of the welded construction provides smooth exterior sur-



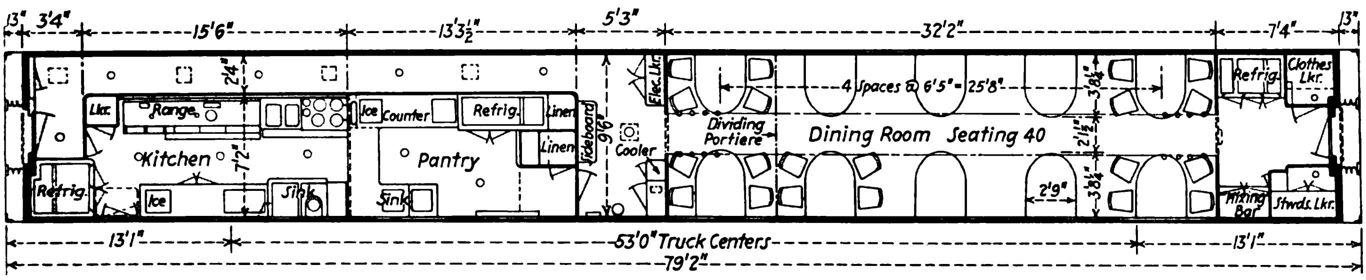
One of the trucks showing the arrangement of the generator drive



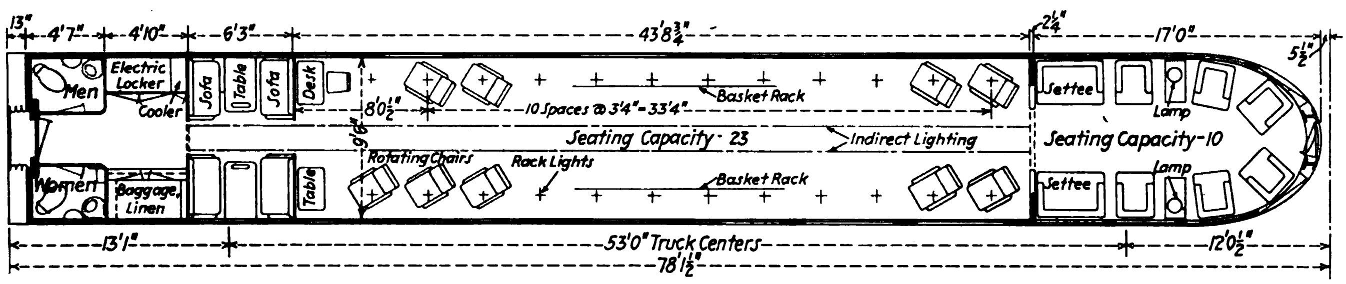
The first coach—For men and women



Articulated body unit with men's smoking room



The dining car



The parlor-observation car

faces on all cars. A lower skirt, curving under the cars, covers all running gear except the trucks and gives a tubular appearance to the train. Rubber diaphragms, painted to conform to the exterior color scheme, cover the gaps between all cars to provide an unbroken exterior surface the length of the train. Car steps, when closed, follow the contour of the curved skirting plate. Marker lights and back-up light are streamlined and molded into the contour of the car body.

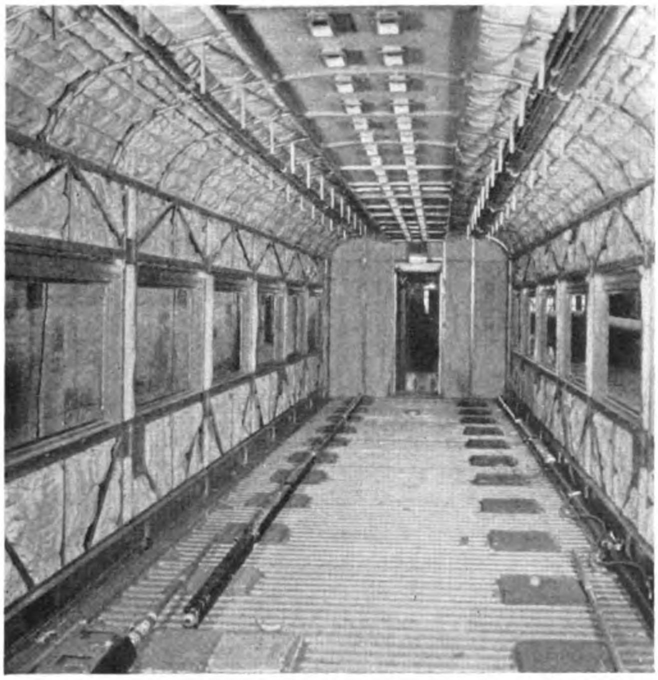
Air-conditioning is complete throughout the train, embodying the latest developments of the steam jet system. Windows are double paned and sealed. Gaps between cars are closed by double diaphragms. The Vapor steam heating system embodies fin-type radiation. All main windows are exceptionally wide for maximum visibility. All inner sash are glazed with clear safety glass, outer windows being sealed against dust and smoke.

A system of indirect lighting is employed in all cars, furnishing primary illumination in diner and settee section of the tavern car and secondary illumination in coaches and parlor cars. Primary illumination in coaches and parlor cars is from individually controlled lights in the parcel rack over each seat. The ceiling structure, enclosing the indirect lighting, is of simple, pleasing design. The bar section of the tavern car

Consist of the New Daylight 12-Car Trains of the Southern Pacific

No. of cars in each train		Length overall per car	Light weight per car	Seating capacity per car
1	Coach, baggage	79 ft. 2 in.	102,500 lb.	44
1	Coach for women and men	79 ft. 2 in.	101,980 lb.	48
3	Coaches for women only*	66 ft. 1 in.	86,260 lb.	50
3	Coaches for men only*	66 ft. 1 in.	84,206 lb.	50
1	Tavern car	79 ft. 2 in.	113,820 lb.	42
1	Diner	79 ft. 2 in.	112,680 lb.	40
1	Parlor car	79 ft. 2 in.	102,620 lb.	33
1	Parlor-observation car	78 ft. 1½ in.	99,340 lb.	41
	Total train car length	870 ft. 5½ in.		
	Total train car weight		1,144,340 lb.	
	Total seating capacity			548

* Each men's and women's coach is articulated at one end, the two cars forming a unit. The weight given is the average for the three cars.



An example of interior construction showing the method of applying insulation—Duct openings in ceiling are for the air-conditioning system

features spectrum lighting which changes constantly through various colors.

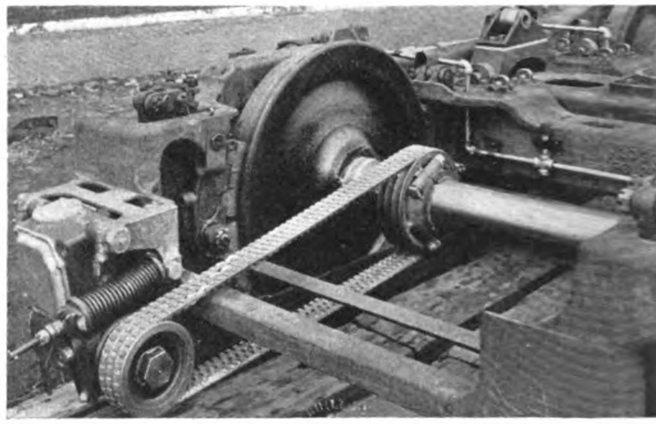
Coach seats are of the rotating reclining type, permitting passengers to face in any direction. Parlor car and observation room chairs are of the rotating, non-reclining type. All chairs are of ultra-modern design, on a framework of metal tubing and fitted with sponge rubber seat and back cushions, displacing the conventional spring cushions, making for greater passenger comfort.

The tavern car is divided into two sections, a tavern section with bar, and a coffee shop section. The bar is a quarter circle, backed by mirrors which give a full-circle illusion. Spectrum indirect lighting changes constantly through yellow, red and blue colors. Settees are of semi-circular design.

Non-articulated car connection with spot-lighted vestibule steps, open and closed

Occupying half of the tavern car, and separated from the bar section by an aluminum and glass partition, the coffee shop features a horseshoe counter surrounded by 24 stools. The interior width of this car, like other cars of the new "Daylight," is 5¼ in. greater than usual, thus for the first time making possible the installation of a horseshoe counter design.

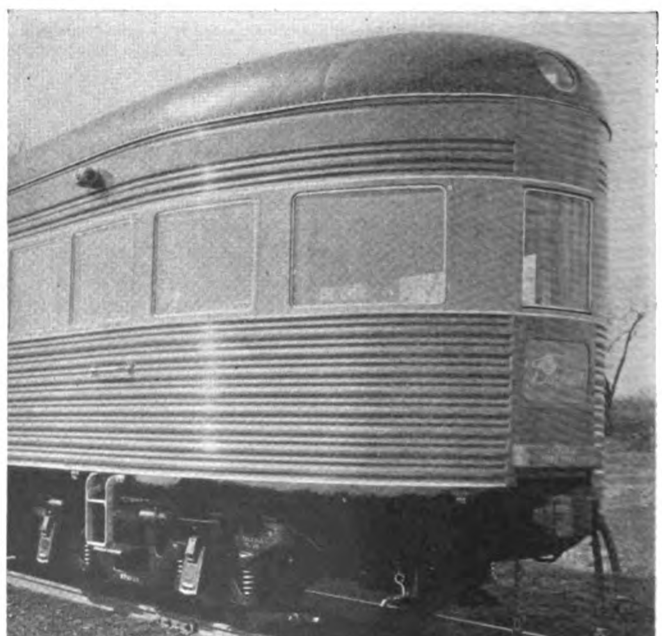
The rear end of the parlor-observation car is oval in



Electric speed control for the brake system, as driven from one of the car axles

shape in keeping with the streamlined train design. Windows, following this contour, extend entirely around the back end of the car as shown in the illustration at the bottom of this column.

The car trucks are of special design, with triple instead of single bolsters for superior riding qualities. Axles are heat treated, larger than usual, and equipped with special lubricating devices. Train brake equipment features the flexibility of the proved straight air brake, but with propagation time cut to a minimum by electrical actuation. The degree of brake application is automatically reduced as train speed is lessened, making possible smoother stops in shorter distances. Tight-lock couplers and rubber draft gears reduce slack between cars, eliminate noise and provide smoother riding qualities.



The rear end of the train

Report of the Union Pacific

Streamliner Brake Trials

Tests on "City of San Francisco" demonstrate the general performance of A H S C brake equipment and effectiveness of deceleration control

Before the Union Pacific high-speed streamline train "City of San Francisco" was placed in service, the New York Air Brake Company and Westinghouse Air Brake Company, in cooperation with the Union Pacific, conducted tests on the A H S C brake equipment with which this train and also the "City of Los Angeles" is equipped. The City of Los Angeles, the first high-speed train to be equipped with the later type A H S C equipment had been placed in service previously, and therefore was not available for tests.

The City of San Francisco was made available for only one day for these tests. The tests were particularly intended to demonstrate the general performance of the air-brake system as a whole, the functioning of the equipment in straight air (electro-pneumatic) and in automatic control, and the effectiveness of the deceleration control as provided by the Decelakron. Stop-distance records at various speeds with different types of brake applications were to be made to obtain actual data on the effectiveness of the brake system.

The City of San Francisco (described in the September, 1936, issue of the *Railway Mechanical Engineer*) comprises two 1,200-hp. locomotive units, one mail-baggage car, one dormitory-baggage car, one diner-lounge car, four sleepers, one coach and one coach-buffet car. The truck arrangements and weights on each truck are shown in Table I. The wheels on all of the cars were made by the Illinois Steel Company of rolled steel, oil quenched and drawn to a Brinell hardness of between 275 and 285. These wheels had the standard A.A.R. taper tread. With the vertical loading of the power car wheels on the worn rails in the territory involved, the bearing area should represent approximately 0.73 sq. in.

The brake shoes were all of the plain or non-flanged type made by the American Brake Shoe & Foundry Company. The power-truck shoes are designated as "Pattern 4396, Diamond S type S B;" they are unchilled, are 3⅜ in. wide by 11 in. long and have an area of 37,125 sq. in. The shoes on the other trucks are designated as "Pattern 4411, Diamond S type S B;" they are 3⅜ in. wide by 9 in. long, and have an area of 30,375 sq. in. Brinell hardness of the shoes is 300. There were four shoes per wheel on each of the 14 trucks.

Description of Equipment

The air-brake equipment used on these trains is a modification of the standard H S C equipment which had previously been furnished on high-speed trains by both the air-brake companies. The modification consists in a rearrangement of the motor-car control units to permit the brake apparatus to be operated as a high-speed straight-air system or a conventional automatic system. This change is accompanied by the incorporation of a change-over valve as a part of the HS-4 brake valve. The change-over valve is moved by the use of the standard brake-valve handle to either straight-air or automatic position as desired. The HS-4 brake valve operates in conjunction with the BA-4 brake application valve, an EP-2 master relay, a Decelakron, and the necessary train-control apparatus. The train-control features function automatically to cause brake applications irrespective of the setting of the change-over valve.

The normal operation of the equipment on high-speed trains will usually be in straight air. During this operation the engineer's brake valve is the means through which the engineer initiates the brake application by admitting air to a fixed-volume reservoir which allows pressure to act on the master relay to energize the application magnets simultaneously throughout the train. Releases are accomplished similarly by means of the control valves, through the master relay.

Each car in the train, including the control units, is equipped with a No. 21 control valve and magnet valve. The No. 21 control valve is the device through which air is admitted to the brake cylinders or released directly therefrom as pressure is developed or reduced in a straight-air pipe by operation of the application or release magnet. When the desired amount of brake application is secured, the Decelakron operates to regulate the degree of application, and to maintain a uniform rate of train deceleration. Thus, after the engineer once initiates a brake application, the Decelakron assumes control to reduce the degree of brake application to maintain a safe margin against wheel sliding.

The initial settings of the Decelakron were as follows: (a) Minimum service, 2 m.p.h. per sec. at full-open position; (b) maximum service, 2.5 m.p.h. per sec. at full-open position; and (c) emergency, 3 m.p.h. per sec. at full-open position. The train was also equipped with conductor's valves whereby the trainmen may make emergency brake applications if found necessary. A backup-valve arrangement was also provided in the last car to permit a trainman to make a service or emergency brake application from that point.

Description of Test Track

All tests were made on the Union Pacific Railroad between Omaha and Columbus. This is a distance of approximately 85 miles, and tests were made running both westward and eastward. Included in this 85 miles run were two sections of track which were staked out for the measurement of stopping distances. Two high-speed test stops were made over these measured sections running westward and two running eastward.

In general the track was slightly ascending when running westward and had Sherman gravel ballast practically all the way. The test stops were made on tangent track. The rail in the test territory represents standard section, weighing 101.48 lb. Part of the rail was laid in 1920 and part in 1923. The chemical properties of the rail are as follows: Carbon, between 0.67 and 0.83 per cent; manganese, between 0.50 and 0.90 per cent; phosphorous, 0.04 per cent; and silicon, 0.15 per cent. The original Brinell hardness of the rail was approximately

285 and would now be considered an average of 300 due to service peening.

Test Instruments

Practically all of the test apparatus and test control equipment were located in the baggage compartment of car 3. This was really the first car in the train, but since each of the two locomotive units had equipment similar to that of the cars, each of these units is counted as a car, thus making an 11-car train. The equipment in car 3 consisted of one trainagraph, one speed-time recorder, one decelerometer, a control panel, and a time clock. Wires extended from this car to the hunch mechanism, which was located on the top of the brake valve in the engineman's cab. Four wires were run through the train to the rear. Two of these wires provided a power circuit for the trainagraph, and the other two wires furnished the hunch and time circuit for instruments located in car 11.

Table I — Train and Braking Ratio Data

Type of car	Truck no.	Weight ready to run, lb.	Actual lever ratio	Total shoe force	Brake ratio at 100 lb. brake-cylinder pres.	Brake shoes: No. per wheel	Brake shoes: Width, in.	Brake shoes: Length, in.
Power	1	112,980	7.96	250,070	222.0	4	3⅛	11
	2	101,960	7.24	227,360	223.5	4	3⅛	11
Power	3	101,960	7.24	227,360	223.5	4	3⅛	11
	4	113,540	7.96	250,070	220.0	4	3⅛	11
Mail car	5	58,560	4.68	147,000	251.0	4	3⅛	9
	6	56,260	4.78	150,100	267.0	4	3⅛	9
Baggage car..	7	64,760	5.37	168,800	261.0	4	3⅛	9
Diner-lounge..	8	65,540	5.37	168,000	258.0	4	3⅛	9
Sleeper	9	70,980	5.83	183,000	258.0	4	3⅛	9
Sleeper	10	67,540	5.62	176,600	262.0	4	3⅛	9
Sleeper	11	71,460	6.01	188,800	265.0	4	3⅛	9
Sleeper	12	67,800	5.55	174,300	257.0	4	3⅛	9
Coach	13	62,980	5.20	163,400	260.0	4	3⅛	9
Coach-Buffet .	14	47,980	5.09	78,400	164.0	4	3⅛	9
Totals		1,064,300		2,554,060	240-mean			
Added weight on test run		8,500						
Total for test		1,072,800			238.1-mean			

Actual weight includes test equipment and supplies as follows:
500 lb. on truck No. 5.
1,500 lb. on truck No. 6.
1,000 lb. on truck No. 7.
Added load under test conditions:
50 men at 160 lb.—8,000 lb. distributed.
Test equipment—200 lb. on truck No. 13.
Buffet supplies—300 lb. on truck No. 14.
Brake cylinders:
Four 10-in. by 8-in. cylinders on trucks Nos. 1 to 13, inclusive.
Four 7-in. by 8-in. cylinders on truck No. 14.

The trainagraph, located in car 3, recorded brake-pipe, brake-cylinder, supply-reservoir, and straight-air pipe pressure. The brake-pipe connection was taken from the bottom of the filter. The brake-cylinder connection was taken from a tapped opening in the B relay valve at the No. 21 control valve. The supply-reservoir pressure connection was taken from the top of the auxiliary-reservoir by-pass check valve. Straight-air pipe pressure was taken from the face of the B relay valve at the No. 21 control valve. The trainagraph located in car 11 recorded similar pressures except that no supply-reservoir pressure connection could be obtained conveniently at this location.

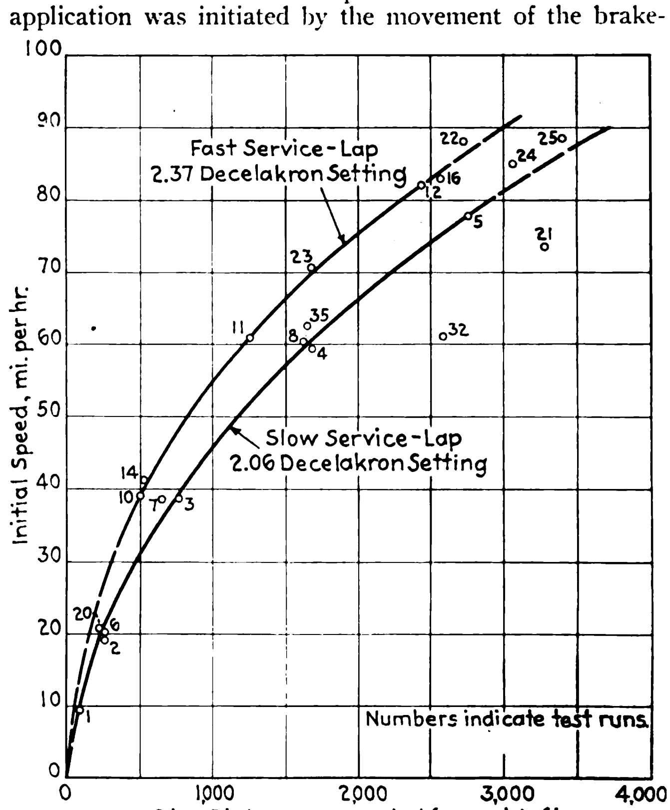
The speed-distance recorder located in car 3 was of the spark type, being controlled from contacts located on the right end of the front axle of truck No. 6. The contactor normally provided one break per revolution with the option of obtaining six breaks per revolution at the lower speeds. This change-over could be accomplished from the control panel. Another solenoid type of speed-distance recorder was located in car 11. The circuit which controlled the recording arm movement on this instrument was provided from a tracer pulley-type contactor located at the center of the rear axle of truck No. 14.

The deceleration recorder, located in the baggage compartment of car 3, was of the slidometer type calibrated to record retardation in miles per hour per second. A Wimperis accelerometer with the dial indications modified to provide readings directly in miles per hour per second was also read during the stops.

An indicating portable contact-type pyrometer provided means for obtaining shoe and tire temperatures immediately following the stops. These readings were not taken after each stop, but were obtained after all of the stops from high speeds. On the westbound runs, the pyrometer contact point was placed directly against the wheel tread. The readings were taken on the rear right wheel and shoe trucks Nos. 4 and 5.

Test Procedure

Successive tests were made starting at Omaha and running westward to Columbus. The train was then turned around on a Y and a return trip made to Omaha, making a total of 24 test stops en route. Communication, by means of telephone, was maintained between the first car and the locomotive cab. The observer in the cab, and the various instrument operators, were each provided with a test schedule containing numbers indicating the sequence of test procedure. When the operator in the cab obtained the proper speed for the next trial, notification was sent by means of telephone to car 3. From that point the man at the control panel started the trainagraph, the speed-time recorder, and threw the hunch switch to its hunch position. When the brake application was initiated by the movement of the brake-



Stopping distances with A H S C brake equipment

valve handle, the hunch circuit was automatically broken at the point in brake-valve movement where straight-air pipe pressure started to develop. As soon as the hunch on the trainagraph in car 1 indicated that the brake application had been started, the hunch switch was thrown over to its "time" position. Test records were continued until the train came to a stop, at which time the hunch and time circuit was broken to provide a stop indication on all the records. The stopping time was

Table II — Performance Data From Road Tests of A H S C Brake Equipment on the "City of San Francisco"

Test No.	Type of application*	Grade at stop, per cent	Initial speed, m. p. h.	Stop time, sec.	Stop distance, ft.	Stop distance corrected for grade, ft.	State of charge at beginning of test: Front car B. P.	Front car S. R.	Rear car B. P.	Retardation, m. p. h. per sec.: Max.	Min.	Brake cyl. pressure, lb.: Front Max.	Front At stop	Rear Max.	Rear At stop	Shoe temp., deg. F., on truck No.: 4 Rear	5 Rear	Notes
1	SS-L	–0.50	9.7	8.1	78.5	70	112.0	105.0	110.0	3.4	..	30.0	10	32.0	10.0	...	...	......
2	SS-L	–0.50	19.3	18.8	303.0	270	116.0	107.0	111.5	..	..	32.0	11	32.0	10.0	...	...	Note A
3	SS-L	–0.50	39.0	26.6	808.0	748	115.0	108.0	111.0	2.8	1.8	47.0	11	50.0	13.0	...	...	......
4	SS-L	–0.50	59.8	36.7	1750.0	1630	115.0	107.0	111.0	2.6	1.8	78.0	14	80.0	13.0	...	...	......
5	SS-L	0	77.7	43.8	2732.0	2732	112.5	109.5	109.0	2.2	1.6	87.5	..	91.0	22.0	370	280	......
6	SS-S	+0.10	20.0	13.0	249.0	254	115.0	106.0	110.5	4.5	2.8	41.0	20	43.0	25.0	...	...	Note B
7	SS-S	+0.07	38.2	17.2	623.0	630	116.0	110.0	113.0	7.0	4.8	72.0	15	75.0	17.0	...	...	Note C
22	FS-S	0	87.9	37.0	2716.0	2716	115.0	109.5	112.0	5.5	..	97.0	14	97.0	16.0	340	380	Note D
8	FS-S	+0.10	60.2	28.8	1597.0	1618	115.0	110.0	112.5	4.5	..	95.0	11	95.0	12.0	...	...	......
23	FS-L	+0.14	70.5	28.2	1650.0	1674	114.5	106.0	110.5	5.0	..	95.0	16	95.0	11.0	...	...	Note E
10	FS-L	0	38.9	15.6	500.0	500	111.5	100.0	106.0	4.4	3.8	84.0	14	79.0	17.0	...	...	......
24	SS-L	–0.14	84.9	43.3	3128.0	3070	115.0	109.0	111.5	3.5	2.0	95.0	11	95.0	11.0	250	220	Note F
14	FS-S	–0.10	40.9	15.8	535.0	530	114.5	106.0	110.5	..	3.5	93.0	22	93.0	40.0	...	...	......
25	SS-S	–0.15	88.5	43.7	3460.0	3390	112.0	104.5	108.0	7.0	3.9	92.0	21	94.5	22.0	360	285	......
11	FS-L	–0.11	61.0	26.4	1256.0	1241	114.0	102.0	109.0	4.0	2.8	91.0	10	92.0	17.5	...	...	......
18	SC-E	–0.10	60.7	23.7	1273.0	1260	113.0	104.0	109.0	6.0	4.8	90.0	28	92.0	40.0	...	...	......
20	TC-S	–0.10	20.3	10.6	236.0	227	98.0	90.0	93.0	7.0	..	50.0	21	52.0	26.0	..	..	......
21	TC-C	–0.14	73.4	46.4	3358.0	3275	108.0	96.0	102.0	7.0	..	55.0	30	56.0	35.0	...	...	......
12	FS-L	–0.18	82.6	36.2	2505.0	2463	113.0	105.0	109.0	5.0	..	94.0	21	94.0	22.0	...	...	......
16	FS-S	–0.05	83.1	36.5	2585.0	2570	115.0	110.0	111.0	7.0	..	94.0	50	95.0	40.0	...	...	......
32	AS-30	–0.13	61.3	44.2	2710.0	2635	106.0	94.5	100.0	6.5	..	85.0	32	54.0	54.0	...	...	Note G
35	AE	+0.24	61.4	28.6	1592.0	1642	90.0	87.0	89.0	..	..	53.0	53	54.0	54.0	240	250	Note H
						Standing tests — Made between running tests Nos. 16 and 32.												
K	AS-10	...	...	...	....	....	....	....	....	..	..	14.0	..	14.0	...	...	...	......
L	AS-40	...	...	...	....	....	....	....	....	..	..	30.0	..	55.0	...	...	...	......
M	AS-20	...	...	...	....	....	....	....	....	..	..	22.0	..	24.0	...	...	...	......
O	AE	...	...	...	....	....	....	....	....	..	..	48.0	..	52.5	...	...	...	......

Test Conditions:
Tests 1, 2, 3, 4, 5, 6, 7, 8, 22, and 23, inclusive were run westbound. The remainder were run eastbound.
Wind velocity was practically zero for all tests.
All stops were made over tangent track.
Original Decelakron setting: Low-pressure service—2 mi. per hr. per sec., wide open; high-pressure service—2.5 mi. per hr. per sec., wide open; and emergency—3 mi. per hr. per sec., wide open.

*Legend:
SS-L—Slow service, brake valve lapped at first Decelakron response.
SS-S—Slow service, brake valve continuously in service position.
FS-L—Fast service, brake valve lapped at first Decelakron response.
FS-S—Fast service, brake valve continuously in service position.
SC-E—Safety control emergency; straight air.
TC-S—Train control, exceeding speed limit.
TC-C—Train control, change in indication not acknowledged.
AS-30—Automatic service, application, 30-lb. reduction.
AE—Automatic emergency.

Notes:
A—Brake valve unintentionally moved to release for an instant when Decelakron operated, then back to lap.
B—Off scale with Buff at stop. Operator moved brake valve to lap for an instant.
C—After test No. 6, Decelakron setting was raised approximately 0.5 mi. per hr. per sec.
D—Off scale with Buff at stop.
E—After test No. 23, high-service setting screw turned in 1.25 turns to 2.37 m.p.h. per sec. in lap.
F—All temperatures on eastbound tests were taken from the tire; temperatures taken during the eastbound run were from the shoes.
G—Automatic electric operation cut out; safety control operative. Change-over to automatic position.
H—Safety control cut out.

also obtained by several observers by means of stop watches.

The stopping distances were not measured on the track except on four tests made over the two sections of measured track. One of the observers in the cab made a record of the initial speed as recorded on the train speedometer, the brake-valve manipulation, the general functioning of the Decelakron and the approximate location of the stop in regard to mile posts. Another observer acted to maintain communication between the test crew and the engineman.

Table III — Decelakron Settings for the Various Tests

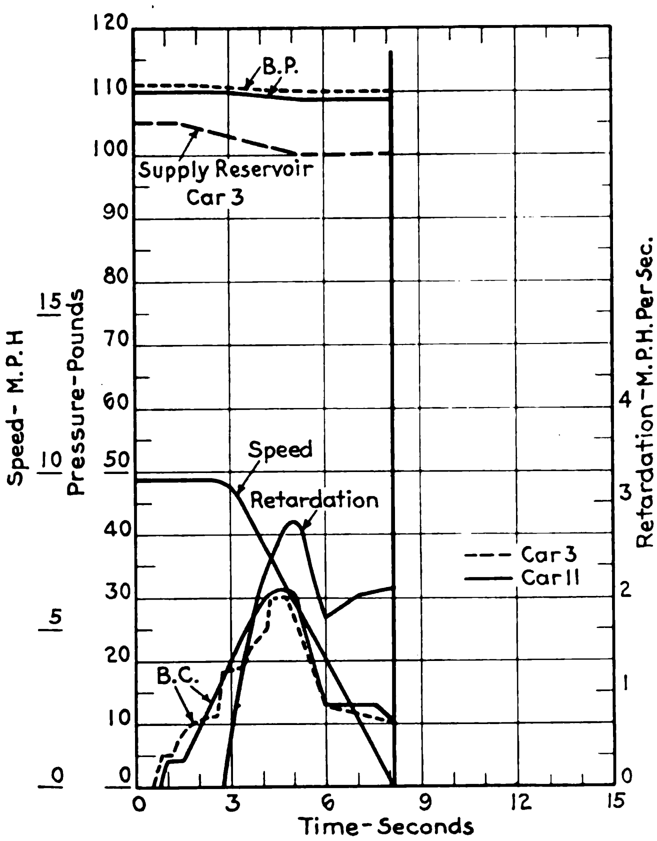
Test number and setting	Settings, m.p.h. per sec.: Full open: Low service	Full open: High service	Full open: Emergency	Lap: Low service	Lap: High service	Lap: Emergency
Initial setting, tests 1 to 6, inclusive	2.0	2.50	3.0	1.56	2.06	2.56
Second setting, tests, 7, 22, 8, and 23 ...	2.0	2.94	3.5	1.56	2.50	3.06
Third setting, tests 10 to 35, inclusive, in the order of test sequence	2.0	2.81	3.5	1.56	2.37	3.06

The Test Program

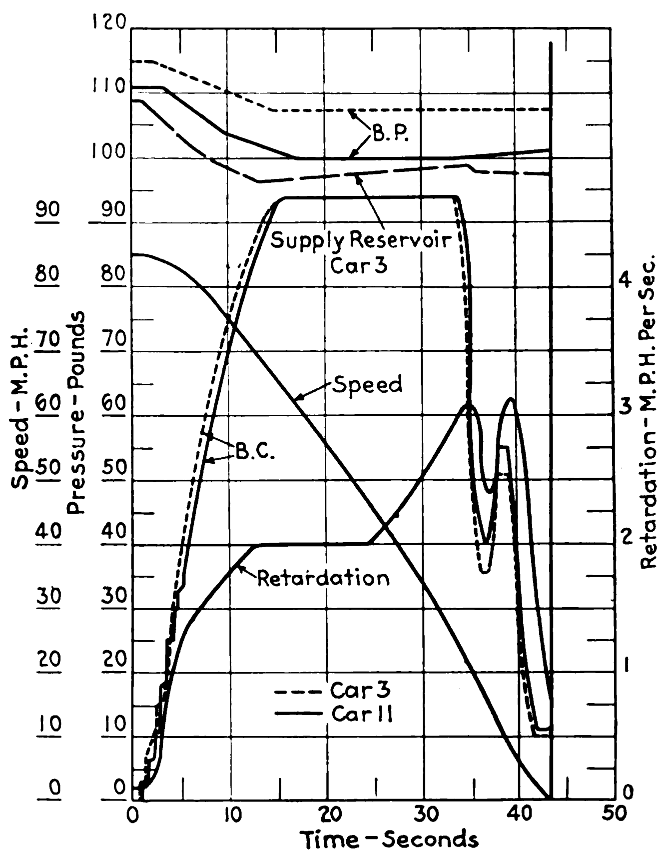
Some of the test instruments were applied to the cars before the train left the Pullman plant at Chicago. The remainder of the test equipment was installed at the Union Pacific car shops in Omaha, just prior to the tests. The instruments were checked to insure that records could be obtained which would be usable in working up the test data. It was impossible with the equipment at hand to provide for hunch and time on the tracer pulley-type speed-distance recorder located in car 11. Since this instrument had been installed merely as a check, the time and hunch were omitted during the tests and the speed records were taken from the instrument located in car 3. The instrument in car 11 was run during all of the tests and proved itself a reliable means of obtaining these data. A number of the records were worked up, assuming constant paper speed, and the results were comparable with those obtained on the spark coil machine in car 3.

Facilities did not avail themselves before the start of the test run for checking the 220-volt a. c. circuit which was used to drive the trainagraphs. This power was supplied by an auxiliary generator located on the train, and at the time the instruments were installed and checked the auxiliary engine could not be operated. This circuit, however, was checked at the start of the test run and, by means of putting the two trainagraphs in series, it was possible to operate the 110-volt motors successfully. The speed of these machines varied slightly, because of the change in frequency with auxiliary-engine speed, but, since the records contain a time indication, they could be worked up accurately.

The weight on each of the axles of the train had been determined by actual weighing at the Pullman plant. The leverage ratio between the brake cylinders and brake shoes was calculated from drawings furnished by the



Test No. 1—Straight-air slow-service stop from an initial speed of 9.7 m.p.h. with brake valve lapped at first Decelakron response—Stopping distance 78.5 ft.



Test No. 24—Straight-air slow-service stop from an initial speed of 84.9 m.p.h. with brake valve lapped at first Decelakron response—Stopping distance 3,128 ft.

Union Pacific. From these two sets of data, the braking ratio for each axle was determined. These values are shown in Table I. The braking ratio averaged 222.2 per cent for the power trucks and 250.3 per cent for the car trucks based on 110 lb. cylinder pressure. The overall braking ratio during the test run was 238.1 per cent.

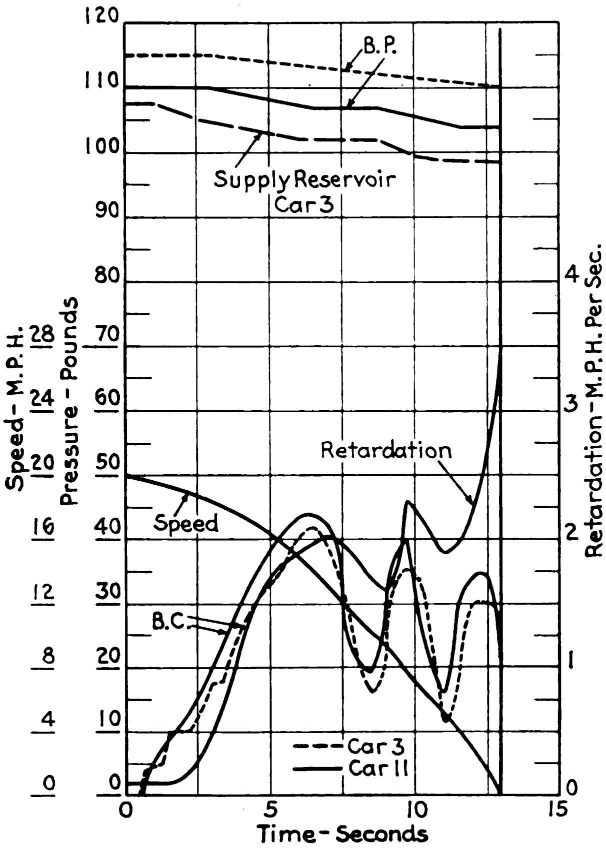
The operation of the pneumatic and electric equipment was checked as completely as time would permit. A check of the records showed straight-air and automatic operation to be as intended. It was impossible, however, to obtain all of the standing-test data which were required in the original test schedule. However, the piston travel was checked on all of the cars and a check was made to insure that effective applications were being received at the wheels before the test run was started.

The train left Omaha and ran westward as far as Columbus, Nebraska. During this run a total of 10 running tests were made. On the return trip 14 running and 5 standing tests were made. When the train reached Omaha, the test instruments were removed and the train was prepared for a run to San Francisco where it was started in revenue service.

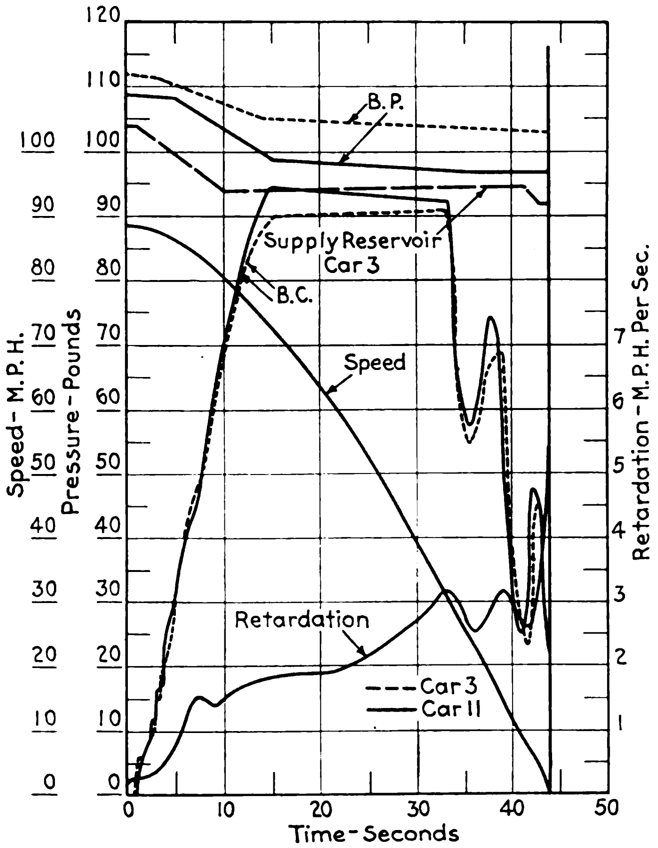
The first series of tests were slow service electro-pneumatic applications with the brake valve lapped when the Decelakron first operated. During this series of tests the Decelakron was set at 2 m.p.h. per sec. in low service (under 35 lb. brake-cylinder pressure); 2.5 m.p.h. per sec. in high service (over 35 lb. brake-cylinder pressure); and 3.0 m.p.h. per sec. in emergency. All of these rates were the values with the Decelakron wide open. No high rates of deceleration were apparent during this series and so the Decelakron setting was raised approximately 0.5 m.p.h. per sec. immediately following test No. 6. This setting resulted in too high rates of deceleration as evidenced by the fact that 95 lb. cylinder pressure was obtained on tests at 60 m.p.h. and over, in which cases venting did not occur until the speed had reduced to about 20 m.p.h. This venting was too late to prevent a rate of deceleration near the end of the stop of about 4 m.p.h. per sec. The Decelakron was set slightly lower for the return trip from Columbus, and after the completion of the tests, was set back to the original value.

Low-service setting relates to the adjustment whereby minimum brake-cylinder pressure is retained at the end of the stop. This prevents complete dumping of brake-cylinder air by the Decelakron as the retardation rate continues to increase at very low speeds. The low-service setting was not changed throughout the tests. High-service setting relates to the Decelakron adjustment as it affects maximum retardation rate during a high-service stop. The high-service setting can be adjusted independently of the low-service and emergency settings. Emergency setting has the same significance as high-service setting except that it permits a somewhat higher maximum retardation, and this adjustment governs only in the case of an emergency brake application. It is also necessary to distinguish between lap and full-open maximum retardation rates as they are governed by the Decelakron setting. Under either condition of high-service or emergency, the difference between lap adjustment and full open is governed by the resistance of the spring which controls the movement of the Decelakron weight. In these particular tests, the initial resistance of the spring was such as to cause a retardation rate differential of 0.44 m.p.h. per sec., i.e., the high-service and emergency settings for the full-open position will show an increase of 0.44 m.p.h. per sec. over the corresponding settings in lap position. Unless otherwise specified, reference to any Decelakron setting indicates the adjustment in the wide-open position. For the exact Decelakron setting for each test see Table III.

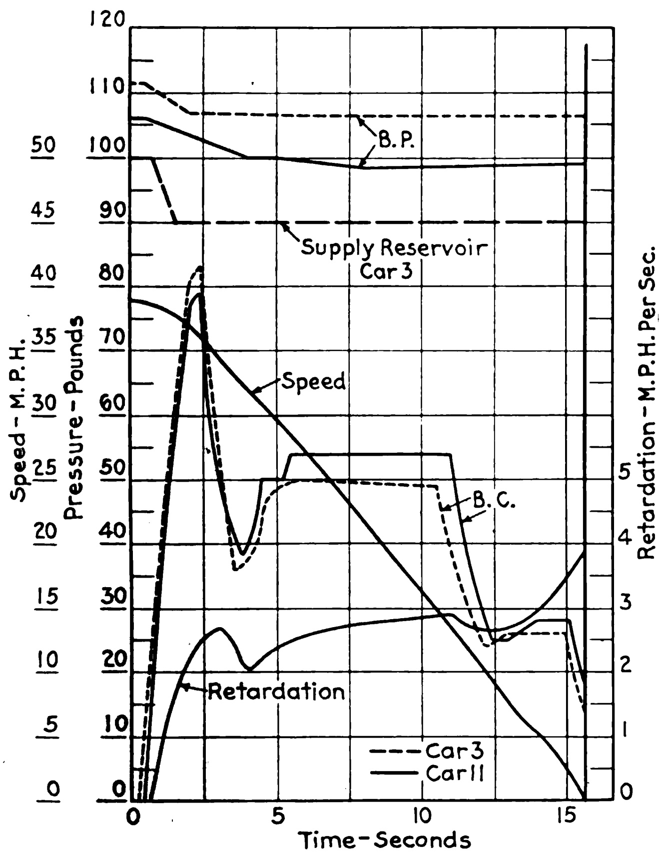
Four principal kinds of electro-pneumatic applica-



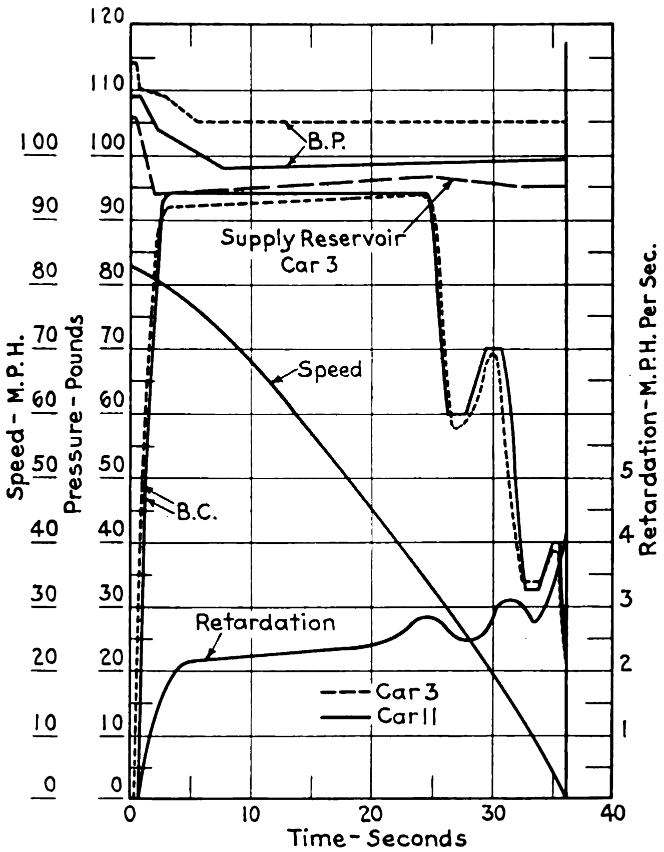
Test No. 6—Straight-air slow-service stop from an initial speed of 20 m.p.h. with brake valve continuously in service position—Stopping distance 249 ft.



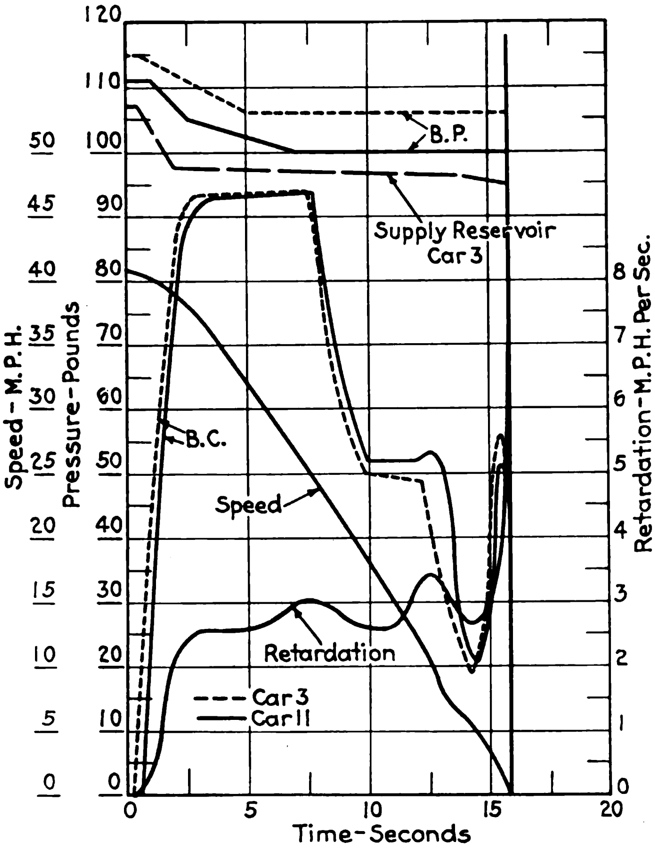
Test No. 25—Straight-air slow-service stop from an initial speed of 88.5 m.p.h. with brake valve continuously in service position—Stopping distance 3,460 ft.



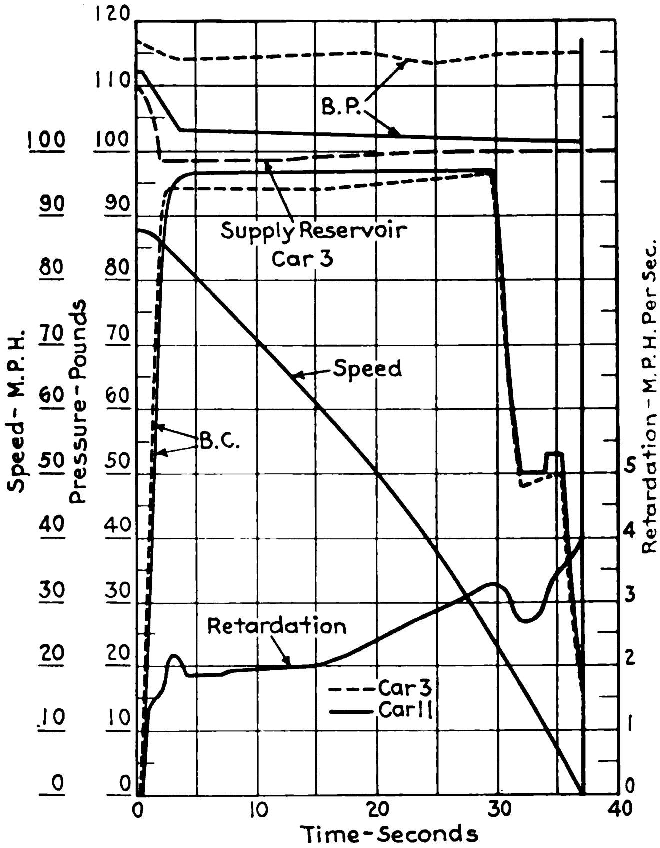
Test No. 10—Straight-air fast-service stop from an initial speed of 38.9 m.p.h. with brake valve lapped at first Decelakron response—Stopping distance 500 ft.



Test No. 12—Straight-air fast-service stop from an initial speed of 82.6 m.p.h. with brake valve lapped at first Decelakron response—Stopping distance 2,505 ft.



Test No. 14—Straight-air fast-service stop from an initial speed of 40.9 m.p.h. with brake valve continuously in service position—Stopping distance 535 ft.



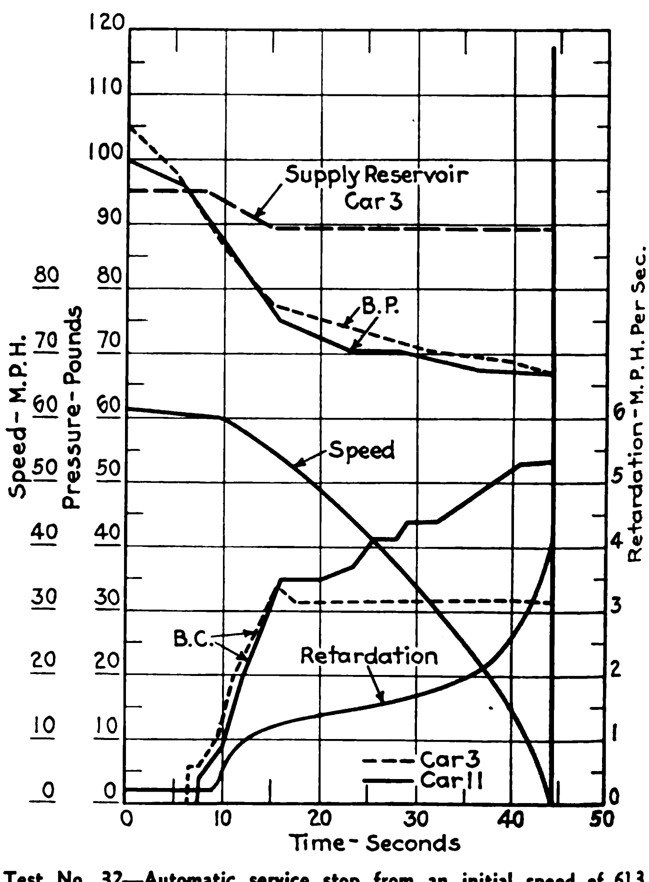
Test No. 22—Straight-air fast-service stop from an initial speed of 87.8 m.p.h. with brake valve continuously in service position—Stopping distance 2,716 ft.

tions were used in the tests. The first consisted of slow service applications with the brake valve returned to lap when the Decelakron first responded. The second series was also slow service, but with the brake valve allowed to remain continuously in service position. The third and fourth series consisted of fast service applications with the brake valve lapped on Decelakron response, and also with the brake valve remaining continuously in service position. These tests were made in the order shown in Table II.

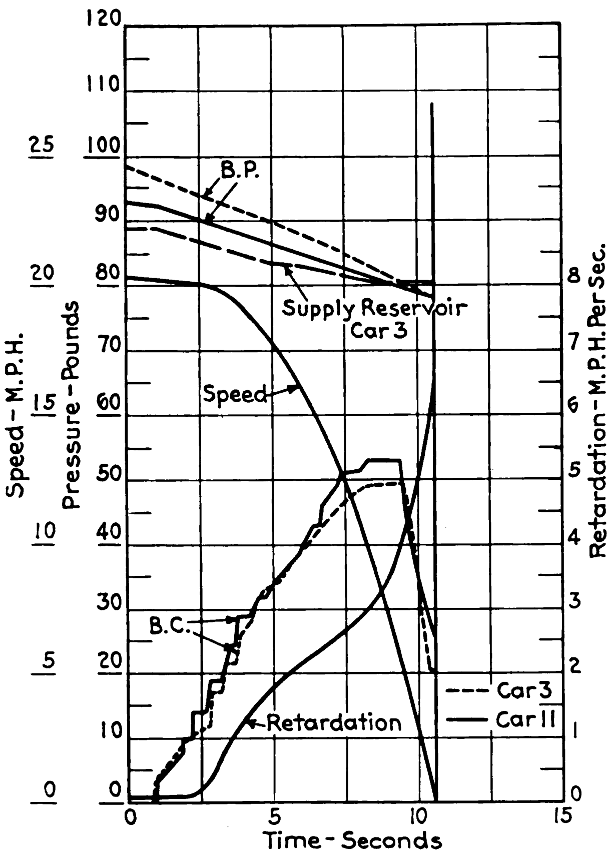
The equipment was changed over to automatic setting for running tests Nos. 32, 35 and 39. The feed-valve pressure was reduced to 90 lb. for all of the automatic tests. One of these tests was a full service application from 61 m.p.h. in which the stop distance was 2,710 ft. Another was automatic emergency application from 61 m.p.h. which resulted in a stop distance of 1,592 ft. The third test, No. 39, was made to demonstrate running releases and applications and is not reported in detail inasmuch as it was impossible to comply with the selected program for this test, and the test was completed over track of varying grade and curvature.

In order to demonstrate the effectiveness of train control, two applications were made, one by exceeding the speed limit and one by failing to acknowledge a change in indication. During these tests the equipment worked as intended, but the retardation rate near the end of the stop was as high as 6.5 m.p.h. per sec. During these train-control applications the hunch on the brake valve was broken manually at the proper time. This manual hunch was necessary because the brake-valve handle was left in release position, at least for the major part of the stop time, in order to simulate a condition when the engineman was incapable of proper response. The operation on these tests was considered satisfactory.

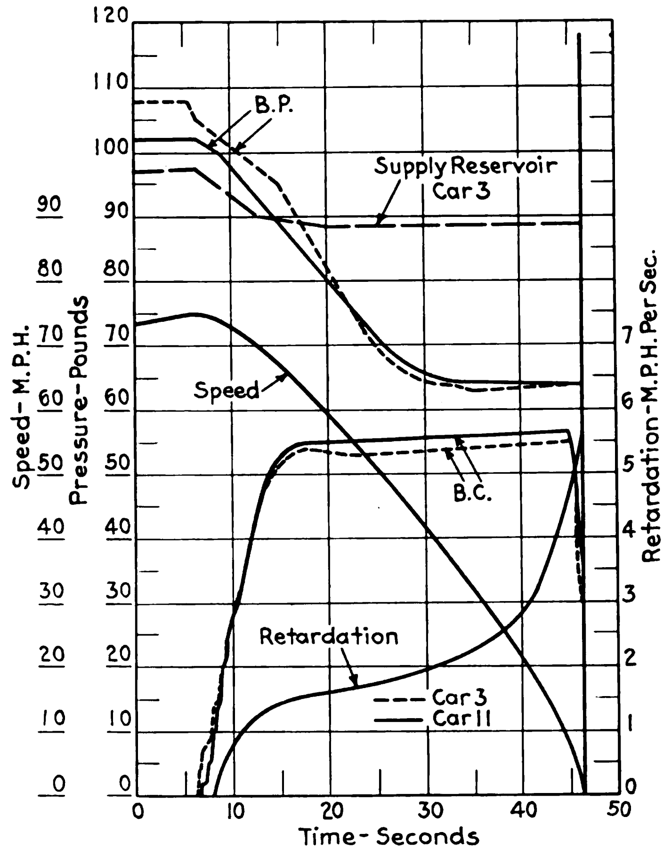
Five standing tests, made while the train was waiting



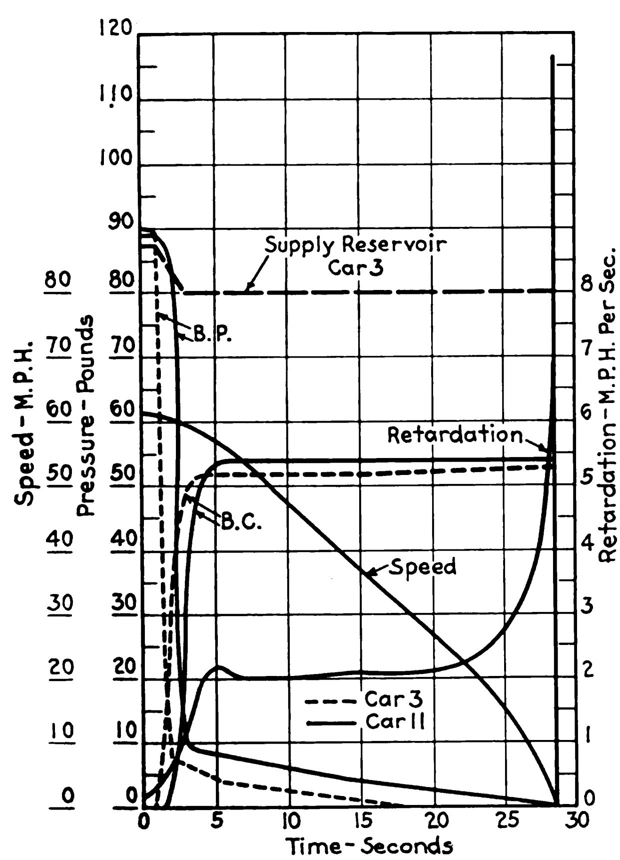
Test No. 32—Automatic service stop from an initial speed of 61.3 m.p.h. During this test automatic electric operation was cut out but the safety control was operative; change-over to automatic—Stopping distance 2,710 ft.



Test No. 20—Train control, exceeding the speed limit—Stopping distance 236 ft. from an initial speed of 20.3 m.p.h.—Retardation at stop 6.5 m.p.h. per sec.



Test No. 21—Train control, change in indication unacknowledged—Stopping distance 3,358 ft. from an initial speed of 73.4 m.p.h.—Retardation at stop 5.5 m.p.h. per sec.



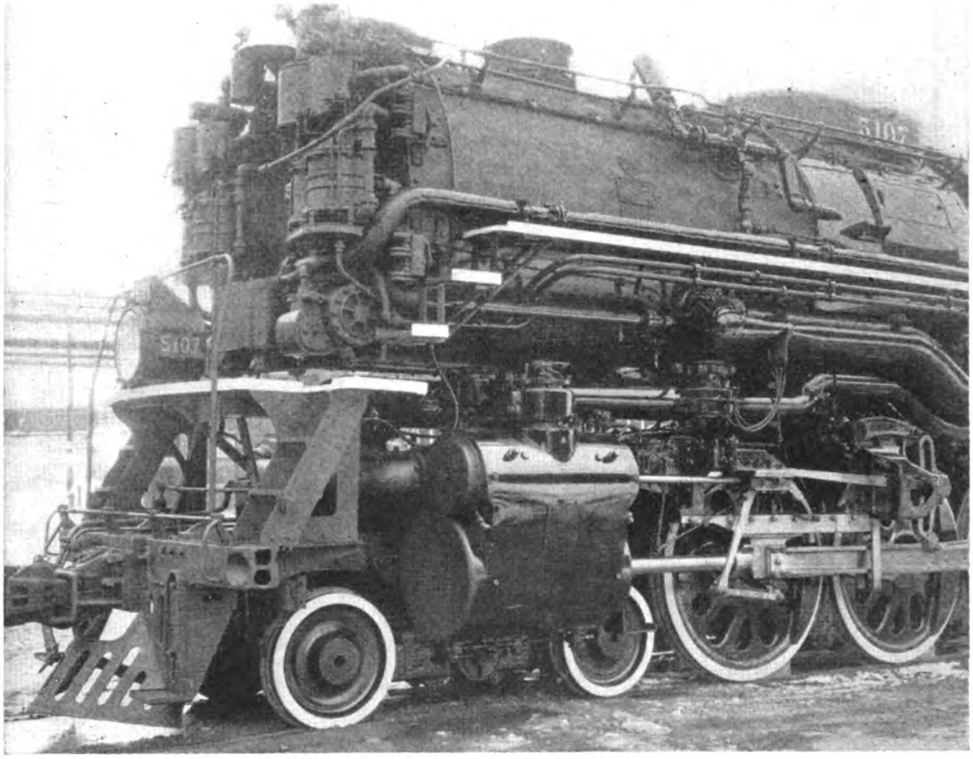
Test No. 35—Automatic stop from an initial speed of 61.4 m.p.h.—Stopping distance 1,592 ft.—During this test the safety control was cut out

on a passing siding, were run to provide records of pressure development during 10-lb., 20-lb., 40-lb. and emergency reductions. The equipment functioned as intended during all of these tests. The general results obtained on the tests are shown in Table II.

Discussion of Test Results

Stopping Distance—No complete series of tests were made under any one condition of brake-valve manipulation and Decelakron setting. For this reason it was impossible to draw accurate conclusions as to relative stopping distances obtained under each of the conditions of tests. There were only two series of tests which contained more than two similar tests. One series consisted of slow service applications with the brake valve lapped at Decelakron response, which included five tests under the same conditions. Another series consisted of fast service applications with the brake valve lapped at the Decelakron response, which included four tests under the same conditions. However, these two series were made with different Decelakron settings which are given in Table III, and therefore are not directly comparable. The stopping distances for these two series are plotted as curves in one on the graphs. The other points under different conditions are plotted on this curve sheet as points only. This graph shows the test numbers for each of the points and the conditions of each test can be readily obtained from the legend in Table II. The stops were about 15 per cent longer in slow service than in fast service, but were practically the same irrespective of whether the brake valve was lapped or remained in service throughout the stop. The stopping distance was about 7 per cent shorter with the 2.37 Decelakron setting than with the 2.06 setting. The stopping distance for the automatic full service reduction was 54 per cent longer than the slow straight-air service stop at the same speed.

(*Continued on page 168*)



Front end of the Northern Pacific 4-6-6-4 type locomotives.

Boiler Dimensions and Grate Area Feature Northern Pacific

High-Speed Freight Power

Single expansion articulated 4-6-6-4 type locomotives designed to burn Rosebud coal similar in general characteristics to 2-8-8-4 type first built for same road in 1928

THE Northern Pacific recently placed in service twelve 4-6-6-4 type articulated locomotives for use in high-speed freight service. These locomotives were built by the American Locomotive Company and while of somewhat smaller capacity than an order of 2-8-8-4 locomotives, the first of which was built in 1928* are in many respects similar to the earlier ones, particularly in relation to total weight, general boiler dimensions and grate area. The fire boxes of these 4-6-6-4 type locomotives are designed to burn Rosebud coal on grates of unusual size. The steam-pipe connections to the front and rear cylinders are similar to the larger locomotives previously mentioned.

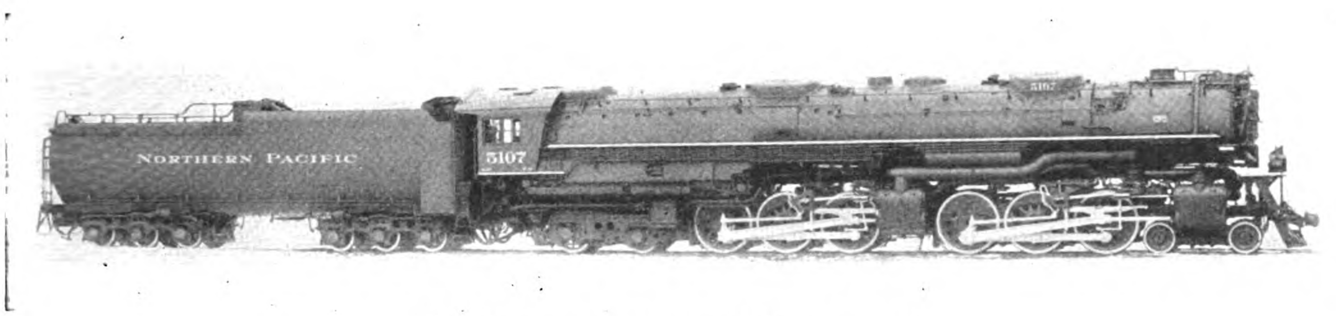
The boiler of the 4-6-6-4 locomotive is of the straight-top radial-stay type and carries a working pressure of 250 lb. The cylindrical courses of the boiler and the top section of the firebox wrapper sheet are of silicon manganese steel. The fireboxes and the side sections of the wrapper sheet are Lukens carbon steel. The firebox is 246⅛ in. long by 114¼ in. wide and a combustion chamber extends 89 in. forward in the barrel of the boiler. The grates are 192 in. long; the remaining 54 in. at the front end of the firebox is separated from the grates by a Gaines wall and sealed to form additional combustion space. The arch is supported on three Nicholson Thermic Syphons, the necks of which are 8 in. in diameter. The grates are of the Northern Pacific rocking pin-hole type developed to burn the Rosebud coal which is high both in moisture and in ash and of relatively low heating value. The coal is fired by a Standard modified Type B stoker, which is of the same general design and size as that installed on the 2-8-8-4 type locomotives. The smokebox is fitted with the railway's standard Cyclone spark arrester.

Flannery type MX flexible staybolts are applied in the breaking zones in the corners and along the tops of the side sheets, and in three of the lower rows of radial stays. A complete installation of flexible staybolts is applied around the combustion chamber. The tube sheets are laid out for the Type A superheater, in the header of which is included the American front-end throttle. All of the locomotives are fitted with Worthington No. 6SA feedwater heaters, and the boilers are equipped with Barco low-water alarms. Blow-off cocks are of the Wilson pneumatic type, two of which have connections to pipes in the boiler for sludge removal and discharge into a muffler on top of the boiler.

The frame construction of these locomotives follows closely that employed on the Union Pacific 4-6-6-4 type engines † delivered by the same builder last fall. The

* For a description of these locomotives, see the *Railway Age* for December 29, 1928, page 1295.

† For a description of these locomotives see the *Railway Age*, December 19, 1936, page 900.



The Northern Pacific high-speed freight locomotive

cast-steel cylinders of the earlier locomotives, however, are of three-piece construction, while those on the Northern Pacific are of two-piece construction and are so designed that all four cylinder castings are interchangeable.

The frames are cast-steel of the bar type, the rear unit being bolted at the back end to the cradle casting and at the front to the cylinders and articulation hinge casting. The bracing of the rear frames is of conventional arrangement.

On the front engine, which has no rigid connection to the boiler, the frames are braced by a series of trunk castings of box section. The first of these extends from the bumper back under the cylinders and terminates just ahead of the front pedestal. It carries the brake cylinders. The intermediate section extends back past the second pedestals and supports the centering device and valve-gear castings. The rear section includes the back pedestal and the articulation hinge assembly as well as the front-engine stabilizing device. All these trunk castings are securely bolted together and attached to the frames by flanges which are securely bolted to the front and back legs of all pedestals. They thus form a continuous torsion-resisting support from the front to the rear end of this unit.

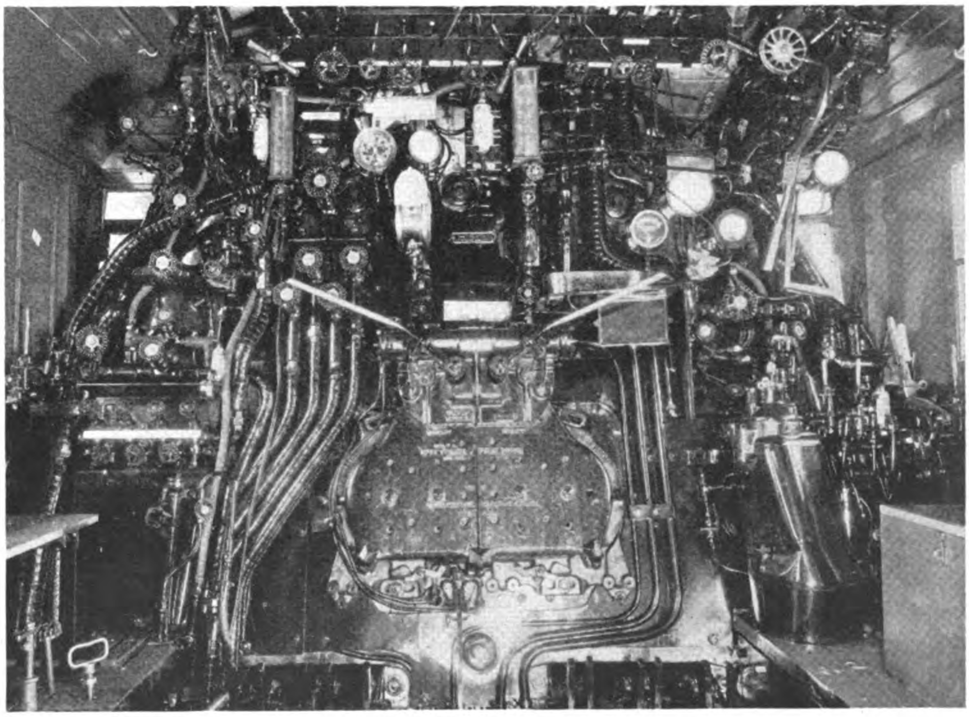
Comparison of the General Dimensions of the Northern Pacific 4-6-6-4 and 2-8-8-4 Type Freight Locomotives

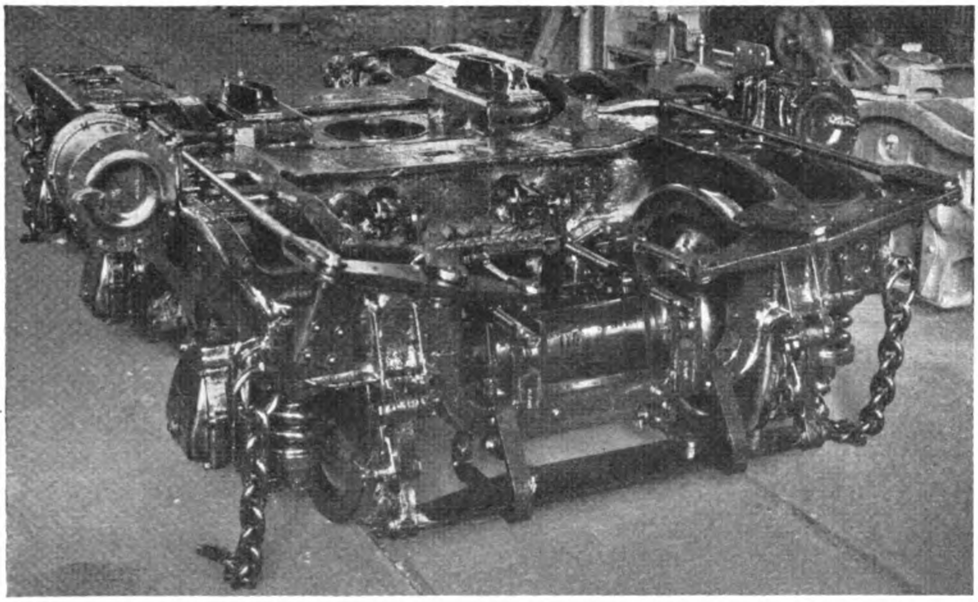
	4-6-6-4	2-8-8-4
Builder	American	American
Year built	1936	1928
Rated tractive force, lb.	104,500	139,900
Booster tractive force, lb.	......	13,400
Total tractive force, lb.	104,500	153,300
Weight on drivers, lb.	435,000	554,000
Total engine weight, lb.	624,500	715,000
Total engine and tender weight, lb.	1,023,000	1,116,000
Cylinders — number, and diameter and stroke, in.	4—23 x 32	4—26 x 32
Boiler pressure, lb.	250	250
Grate area, sq. ft.	152.3	182
Total evaporative heating surface, sq. ft.	5,832	7,673
Superheating surface, sq. ft.	2,114 (Type A)	3,219 (Type E)

The boiler is supported at one point on the front frame system and the stabilizing device, which is similar to that applied on the Union Pacific locomotives previously referred to, tends to prevent synchronous rocking oscillations of the front frame system about the boiler support as a pivot. This is a friction device, the movable element in which is attached to a crank arm on the horizontally pivoted hinge casting at the rear end of the unit. Further resistance to the setting up of synchronous vertical rocking of the front frame system is provided by a snubbing device in the engine truck of the same type as that employed on the Union Pacific locomotives.

The six-coupled driving wheels in each unit are of the builder's Boxpok type. The driving axles on eight of the locomotives are fitted with Timken roller bearings mounted in two-piece housings. On four of the locomotives the driving axles are fitted with crown-bearing boxes and Franklin grease cellars. The main boxes are of the Grisco type. The pedestals on these locomotives are fitted with Franklin adjustable wedges. The

Arrangement of piping on the boiler back head

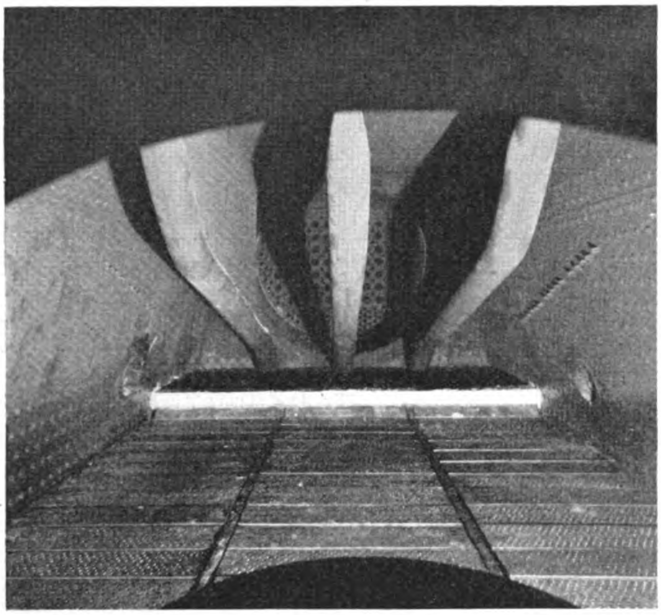




Commonwealth six-wheel equalized tender truck equipped with Timken roller bearings and Simplex unit-cylinder clasp brakes

front pair of driving wheels in each unit is fitted with the Alco lateral cushioning device.

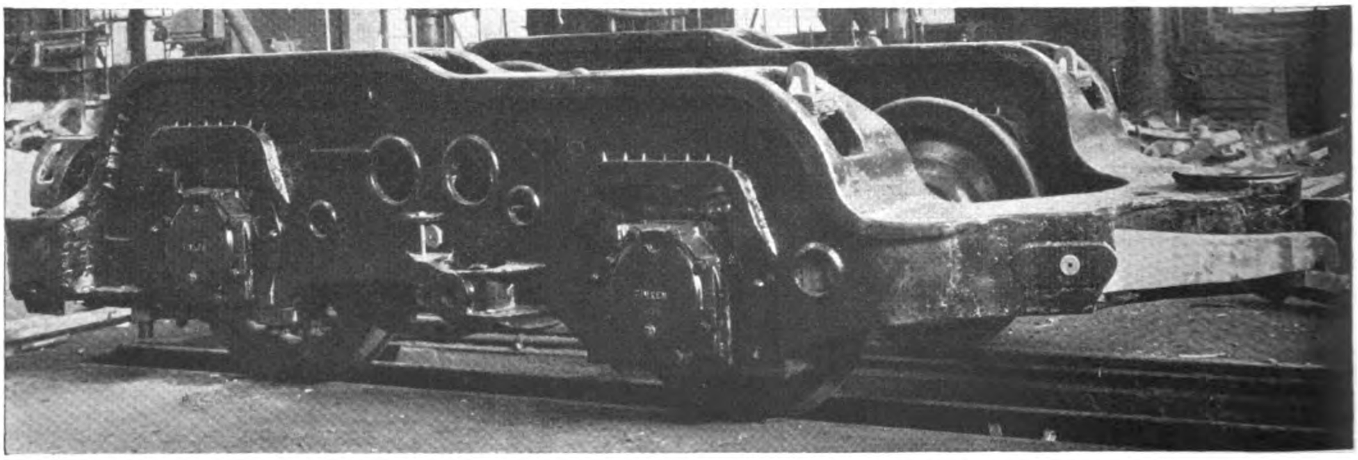
The locomotives are fitted with Alco lateral resistance trucks of the geared roller type. These are designed to produce a low initial resistance, building up to a higher constant resistance after about 1 in. movement. A vertical damping device with rotating friction plates designed by the builder is incorporated in these trucks. The trailing truck is of the Commonwealth four-wheel Delta type. The centering device in these trucks is arranged with a low initial resistance, building up to a higher constant resistance after a small movement, similar in function to that on the engine trucks. The axles of both trucks are fitted with Timken roller bearings; those on the inside journals of the engine truck are of the single-housing type. The front axle of the trailing truck is also equipped with the Timken lateral motion device. The engine truck and the front axle of the trailing truck have Bethlehem heat-treated wrought-steel wheels, as do the tender trucks also. The rear trailing-truck wheels are cast-steel centers with steel tires.



Looking inside the firebox

The main and side rods are of carbon steel, fitted with floating bushings on the main pins and solid bushings on the front and back pins. The main crank pins are of low-carbon nickel steel and the others of carbon steel.

Solid Z-section piston heads of electric cast steel are employed. These are fitted with the Locomotive Finished Material Company's bronze packing rings. The piston rods are of carbon steel and the crossheads of Univan cast steel, fitted in guides of the multi-bearing



Commonwealth four-wheel trailer truck equipped with Timken roller bearings

type. The crosshead bearing surfaces are lined with blocked tin. The piston rods and valve stems are fitted with U. S. metallic packing and Viloco lubricators are applied to the piston rods. The cylinder bushings, valve bushings, valve packing and bull rings are of Hunt-Spiller gun iron.

General Dimensions, Weights and Proportions of the Northern Pacific 4-6-6-4 Type Locomotives

Railroad	Northern Pacific
Builder	American Locomotive Company
Type of locomotive	4-6-6-4
Road class	Z-6
Road numbers	5100-5111
Date built	1936
Service	Freight
Dimensions:	
Height to top of stack, ft. and in.	16–11½
Height to center of boiler, ft. and in.	11– 0
Width overall, ft. and in.	12– ⅛
Cylinder centers, both engines, in.	91
Weights in working order, lb.:	
On drivers	435,000
On front truck	73,000
On trailing truck	116,500
Total engine	624,500
Tender	398,500
Wheel bases, ft. and in.:	
Driving	35– 1
Rigid	12– 2
Engine, total	61–10
Engine and tender, total	113– 8
Wheels, diameter outside tires, in.:	
Driving	69
Front truck	33
Trailing truck	37 front 45¾ back
Engine:	
Cylinders, number, diameter and stroke, in.	4 – 23 x 32
Valve gear, type	Walschaert
Valves, piston type, size, in.	12
Maximum travel, in.	7½
Steam lap, in.	$1\frac{9}{32}$
Exhaust clearance, in.	⅜
Lead, in.	$\frac{5}{16}$
Cut-off in full gear, per cent	84.7
Boiler:	
Type	Straight-top
Steam pressure, lb. per sq. in.	250
Diameter, first ring, inside, in.	96⅜
Diameter, largest, outside, in.	102
Firebox, length, in.	246–⅛
Firebox, width, in.	114¼
Height mud ring to crown sheet, back, in.	78⅞
Height mud ring to crown sheet, front, in.	90
Combustion chamber length, in.	89
Thermic syphons, number	3
Tubes, number and diameter, in.	192–2¼
Flues, number and diameter, in.	73–5½
Length over tube sheets, ft. and in.	23–0
Fuel	Rosebud coal
Grate type	U. P. round-hole table
Grate area, sq. ft.	152.3
Heating surfaces, sq. ft.:	
Firebox and comb. chamber	626
Thermic syphons	213
Firebox, total	839
Tubes and flues	4,993
Evaporative, total	5,832
Superheater (Type A)	2,114
Combined evap. and superheat.	7,946
Feedwater heater, type	Worthington 6Sa
Tender:	
Style	Semi-Vanderbilt
Water capacity, gal.	20,000
Fuel capacity, tons	27
Trucks	Six-wheel
Journals, dia.	6.754 (roller bearings)
General data, estimated:	
Rated tractive force, engine, lb.	104,500
Weight proportions:	
Weight on drivers ÷ weight engine, per cent	69.8
Weight on drivers ÷ tractive force	4.17
Weight of engine ÷ comb. heat. surface	78.8
Boiler proportions:	
Firebox heat. surface, per cent combined heat. surface	10.5
Tube-flue heat. surface, per cent combined heat. surface	63.0
Superheat. surface, per cent combined heat. surface	26.6
Firebox heat. surface ÷ grate area	5.5
Tube-flue heat. surface ÷ grate area	32.8
Superheat. surface ÷ grate area	13.8
Combined heat. surface ÷ grate area	52.0
Tractive force ÷ grate area	685.0
Tractive force ÷ combined heat. surface	13.2
Tractive force x dia. drivers ÷ combined heat. surface	907.5

The valve motion on these locomotives is of the Walschaert type arranged so that the link blocks on both front and back units are in the lower portion of the link in the go-ahead position. The reverse gear is the Alco Type G.

Each locomotive is fitted with one Detroit hydrostatic lubricator, which furnishes oil for the stoker and air compressors, and four force-feed lubricators. Two of these are Detroit six-feed, 32-pint, located on the front engine with feeds to cylinders, valves and guides. The other two are King 30-pint lubricators, one a six-feed and one a seven-feed, located on the rear engine with feeds to cylinders, valves, guides, steam-pipe joints and hinge pins.

The two 8½-in. cross-compound air compressors and the hot-water pump are mounted on the smokebox front, which is of cast steel with the brackets for the pump and strap portion of the Okadee hinge cast integral. Two sandboxes of large capacity are applied on top of the boiler. The running boards are Safkar type plates. The air-brake equipment is Westinghouse No. 8-ET.

The tender tank is of the semi-Vanderbilt type with a coal capacity of 27 tons and a water capacity of 20,000 gallons. The tender frame is of the General Steel Casting water-bottom type, and the tank is of welded construction throughout. The coal space is fitted with a Standard Stoker coal pusher.

The tender trucks are of General six-wheel equalized type and are fitted with Timken roller bearings. The truck clasp brakes are of the Simplex unit-cylinder type.

The principal dimensions and data are shown in one of the tables.

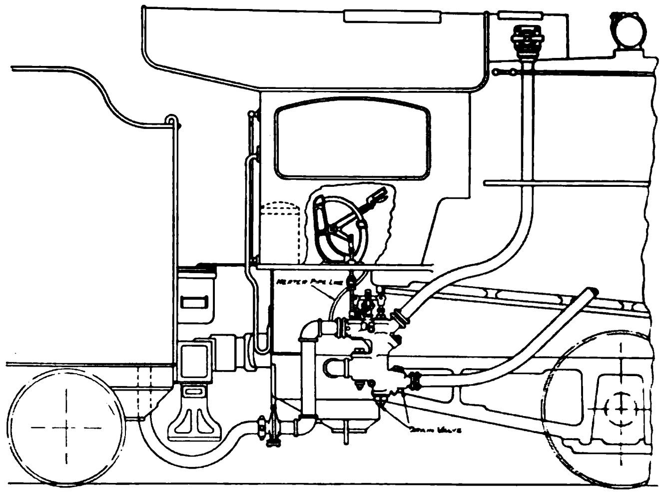
* * *

Interior of one of 12 passenger cars under construction at the Newport shops of the Victorian Railways of Australia. The truck frames, truck bolsters, center sills, side sills, roofs, and side sheets are all of light-weight design incorporating U.S.S. Cor-Ten Steel. All the floor sheets are of 20-gage plug-welded corrugated material welded to 5/32-in. floor longitudinals. The cars are for one of the Victorian Interstate express trains

Injector Operated By Single Control

Complete control by means of a single operating lever is perhaps the outstanding feature of the Type S injector recently developed by William Sellers & Company, Inc., 1600 Hamilton Street, Philadelphia, Pa. This injector is so designed that the several functions such as opening the water valve, opening the steam valve and closing the overflow are performed by means of a single control. The Type S injector is of the combined lifting and non-lifting type so that it may be located high enough above the rail to eliminate the possibility of damage from the roadway and yet drain the water from the lowest point in the tank. One of the features of this injector is that of quick starting, there being embodied in the design a self-closing overflow which eliminates loss of water along a roadway when the injector is starting or feeding. Other important features are the prevention of damage to tank hose as a result of steam passing back into the tank, also the positive prevention of damage to the injector body and the bulging of steam pipes as a result of water hammer.

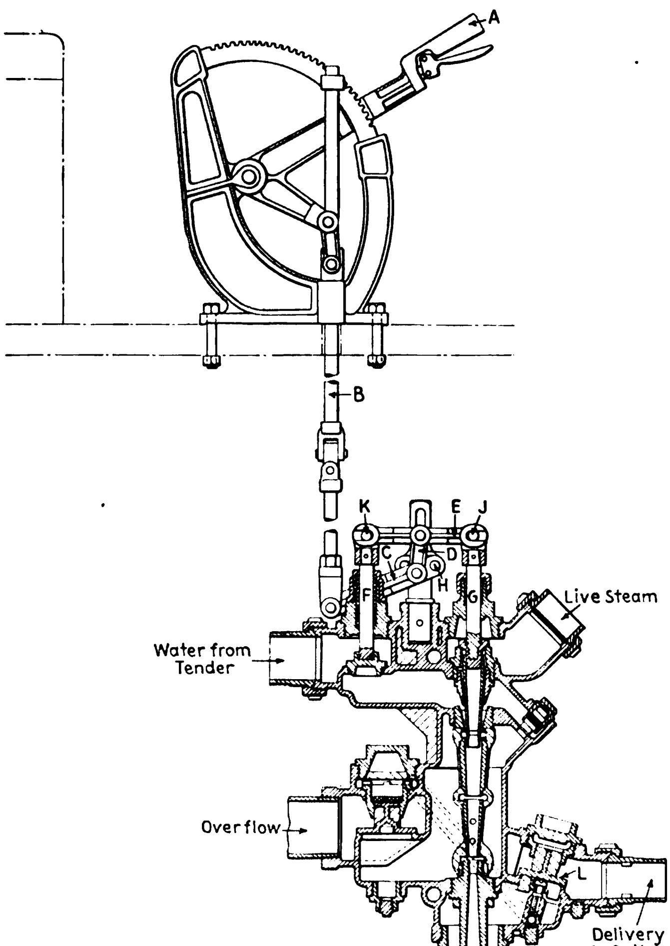
One of the accompanying drawings shows the arrangement of the operating lever and connections as well as a sectional view of the injector itself. The functions of the injector are controlled by the lever *A* which when pulled wide open feeds the boiler at maximum capacity. In order to throttle the injector feed so as to supply the boiler at a rate less than maximum capacity, this lever



A typical installation of the Type S injector. Its location is not limited by the height of the tender bottom

is moved forward to the desired position. The movement of the lever *A* to the extreme forward or down position completely stops the feeding. When the lever *A* is pulled back toward the operator the rod *B* moves upward causing the lever *C* to rotate on its fulcrum pin *H*. This movement in turn pushes upward the two links *D* and the yoke *E*. The upward movement of this yoke *E* is however not in a straight line but fulcrums on the pin *J* so that the pin *K* describes a partial arc and raises the spindle *F*. The steam valve, which is attached to the lower end of the spindle *G*, is held on its seat by the full boiler pressure whereas the water valve, attached to the spindle *F*, is subjected only to the downward pressure of the water in the tank. As the spindle *F* reaches its maximum upward stroke and the water valve stops against its stuffing box any further movement of the lever *A* causes the yoke *E* to fulcrum about the pin *K* and raises the spindle *G* and the attached steam valve from its seat. When the steam valve reaches its maximum opening the jet within the injector tubes is completely formed and as it reaches a velocity sufficient to overcome boiler pressure it raises the line check valve *L* from its seat. When this line check valve moves upward it lifts a small pilot valve attached to it from its seat thereby admitting pressure through a port to a chamber above the overflow valve *M* exerting a downward pressure on the latter locking it to its seat.

In order to throttle the injector feed to suit the evaporation of the boiler the lever *A* is moved partly forward causing a downward movement of the rod *B*, the lever *C*, the link *D*, the yoke *E* and then fulcrums on the pin *J*. The movement of the latter is reversed from that which occurred on the opening movement, the boiler pressure being under the steam valve attached to the spindle *G* so that the steam valve cannot move downward to its seat until the water valve attached to spindle *F* is first seated. Further upward movement of the lever *A* serves to seat both the water and the steam valves. Boiler pressure then closes the line check *L* and the pilot valve, the pressure then being permitted to exhaust from the chamber above the overflow valve which opens and permits any excess water to drain from the injector casing.



Arrangement of the operating lever and connections and a sectional view of the Type S injector

The Type S injector is made in three sizes, the Type SL being designed for the delivery of 4,900 to 5,800 gal. per hour; the Type SR for 6,500 to 7,500 gal. per hour and the Type SW for capacities of 8,000 to 12,000 gal. per hour. The Type X injector is similar in general construction to the Type S but is designed for operation at boiler pressures up to 350 lb.

Timken Fuel-Injection Pump For Diesel Engines

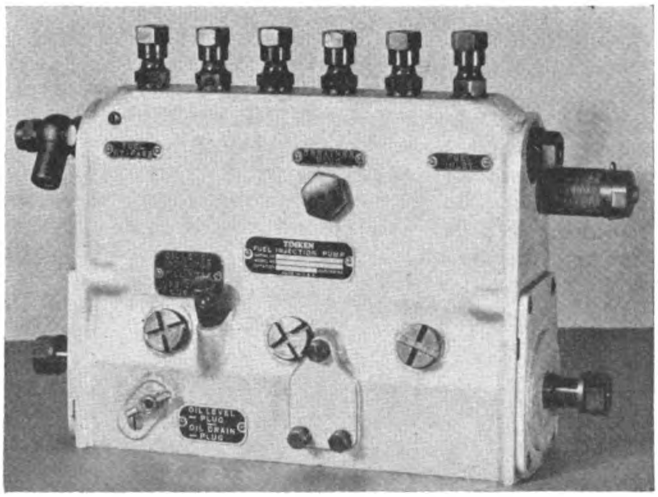
To meet the demand for a dependable high-speed solid-injection fuel pump for Diesel engines, The Timken Roller Bearing Company has developed two sizes of multiple-unit, integral-cam-shaft pumps, one using a 4 to 9 mm. range of plunger sizes and the second a 5 to 11 mm. range. At present these pumps are being made for one-, two- and six-cylinder engines. These fuel pumps are the result of three years of laboratory development plus a full year of testing in the field on commercially-operated Diesel trucks, buses and tractors.

As will be seen from the accompanying diagrams, these pumps are of the cam-operated helical-plunger type, the metering being adjusted at the factory and sealed. At the lowest position of the plunger the cylinder receives a charge of oil from the feed line, which is kept filled by a special feed pump connected to the fuel tank. Delivery of the fuel to the engine starts as soon as the piston covers the inlet port and ends when the upper helical edge of the annular groove in the piston opens the overflow or by-pass port on the opposite side of the pump cylinder wall, releasing the pressure to the discharge line. The effective delivery stroke of the piston may be regulated by turning the piston in its cylinder or barrel to vary the point of the delivery stroke in which the overflow port is uncovered.

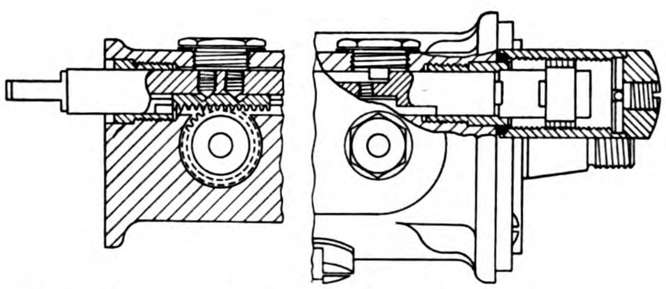
An outstanding feature of these Timken pumps is that they are driven by constant velocity cams. Thus the delivery speed of the fuel entering the combustion chamber of the engine is maintained constant at a speed adapted to the rate of combustion, thereby increasing the engine efficiency and fuel economy. The deceleration portion of the motion comes late in the stroke, thus permitting the use of a lighter spring and reducing the spring load between the tappet and the cam.

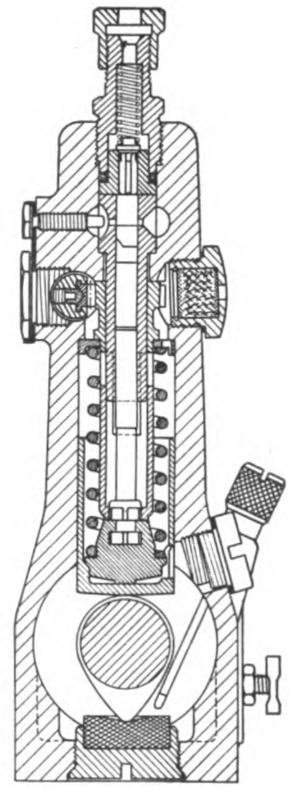
For adjusting the pistons to vary the amount of fuel delivered, a simple and positive method has been devised. This comprises a rack rod which extends horizontally along the rear face of the pump, meshing with precision cut gears on the upper ends of the driving sleeves. The upper or driving sleeve for each piston may thus be rotated on the barrel of the pump. This upper sleeve is tongue and groove connected with the lower sleeve, which fits on the piston. As the upper sleeve is rotated on the barrel, the lower sleeve rotates the piston, thereby changing the position of the helix with respect to the relief port.

Surrounding these sleeves are light helical springs that serve to retract the pistons and hold the driving sleeves in position. The tappet cup is so designed as to provide a minimum of wearing surface between the cam and the pump plunger and is made of a new type graphitic steel recently developed by the Steel and Tube Division of the Timken Roller Bearing Company. This steel, which contains free graphite, can be heat treated to provide the extremely hard wear-resisting surface desired and the graphite acts as a lubricant retainer in the polished surface, thereby assuring positive lubrication at all times and long accurate life under the severe lubrication conditions which exist in every Diesel injection pump.



Exterior of Timken fuel injection pump for six-cylinder Diesel engine





The three views in this drawing show, from right to left, a vertical section through the pump, a horizontal section through the rack stop and a horizontal section through the rack

The tappet and spring design is such as to eliminate the need for an adjusting screw between the plunger and the spring, the tappet cup adjustment depending upon the accuracy of the parts. This is not subject to field adjustment and is made in the factory to precision standards. Riding as it does on the cam, the tappet spins, holding wear to a minimum. Likewise its use reduces the number of parts between the cam and the plunger and permits the installation of a safer spring which is

not subject to breakage at annoyingly frequent intervals.

To adjust the individual metering sleeves on the plungers the rack rod is provided with a series of detachable rack sections which mesh with the gears of the metering or driving sleeves. These are adjusted longitudinally on the rack rod and locked in position by means of two horizontally spaced parallel screws with conical ends. The space between the two screws is less than the space between the conical recesses in the movable sections, thus enabling the sections to be moved in slight but definite and positive increments as the screws are tightened and loosened.

A special stop is provided in connection with the rack rod which controls the metering sleeves whereby the maximum amount of fuel delivered to the engine may be definitely limited. At one end of the rack a knurled nut controlling the stop is provided by means of which the maximum amount of fuel can be limited according to the altitude at which the engine is working. A series of cotter pin holes is drilled through this nut, the space between each hole representing the change required in adjustment for a thousand foot change in altitude.

The piston rotating mechanism has several notable advantages. The toothed rack sections may be quickly and easily removed and replaced when worn or damaged. They may also be adjusted independently of each other to obtain uniform angular adjustment of all pistons without removing the rack bar or dismantling the pump.

As these pumps must operate under pressures running as high as 10,000 lb. per sq. in. and the clearance between the plunger and the bore of the pump barrel is only .000030 in., it is essential that the housing be specially designed to provide the necessary stiffness, for even the slightest deflection would affect the accuracy of the unit. This has been done by the use of special alloy steels to assure the strength needed.

For convenience in installation and in line with American practice, Timken fuel injection pumps are all made to fit standard bases and all connecting parts conform to standard dimensions. Likewise all parts are made on the American production plan, being interchangeable and easily replaced when necessary directly from conveniently located stocks.

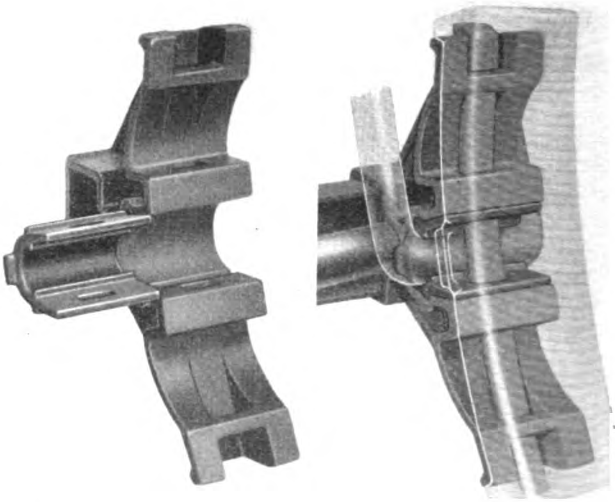
The Type A or small size pumps using a 4 to 9 mm. range of plungers is adapted for use on Dissel engines up to approximately 150 hp. and operates at speeds up to approximately 4,000 r.p.m. The Type B, using a 5 to 11 mm. range of plungers, is ordinarily used on engines from 110 to 250 hp., operating at speeds up to approximately 3,000 r.p.m.

Economy Brake Head And Wear Plate

Brake head wear is accentuated by modern high operating speeds, developing first on the shelf where the shoe lug bears and then on the hanger eye. It follows that toe wear develops as soon as the lower shelf is worn so that the shoe drops and cuts into the toes.

To meet this condition, the Illinois Railway Equipment Company, Chicago, has developed and is now marketing the Economy brake head and wear plate, in which a renewable wear-resisting drop-forged steel plate takes all shoe lug and hanger wear. Tapered splines on the top and bottom of the plate provide a tight press fit in the head. An extended lug on the plate bearing against the tension rod locks the plate in the head when the beam is assembled.

This construction is said to make the brake head last



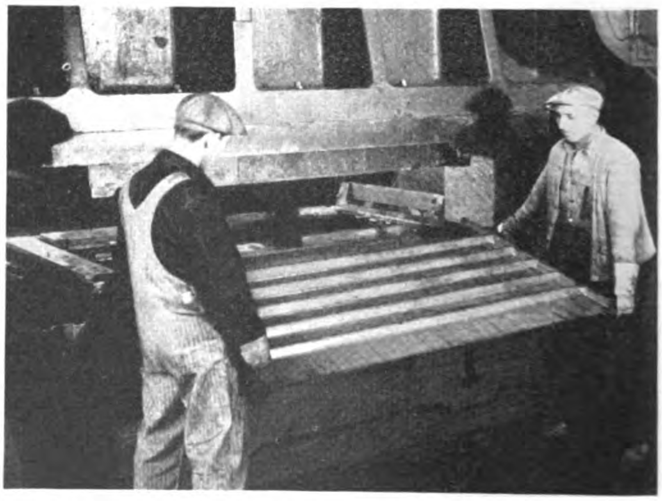
Drop-forged steel wear plate, before and after application in the Economy brake head

indefinitely and to meet A.A.R. specifications as an approved alternate standard. It assures reliable brake head performance at substantially reduced overall cost.

Light-Weight Nickel-Copper Steel Car Doors

Difficulties previously encountered in cold-forming operations which called for deep drawing steel have been materially reduced in recent production of box-car doors by the Youngstown Steel Door Co., Youngstown, Ohio. This manufacturer reports that door panels having a three-way draw at the end of each corrugation involved less spring back than is usually encountered in the high-strength steels.

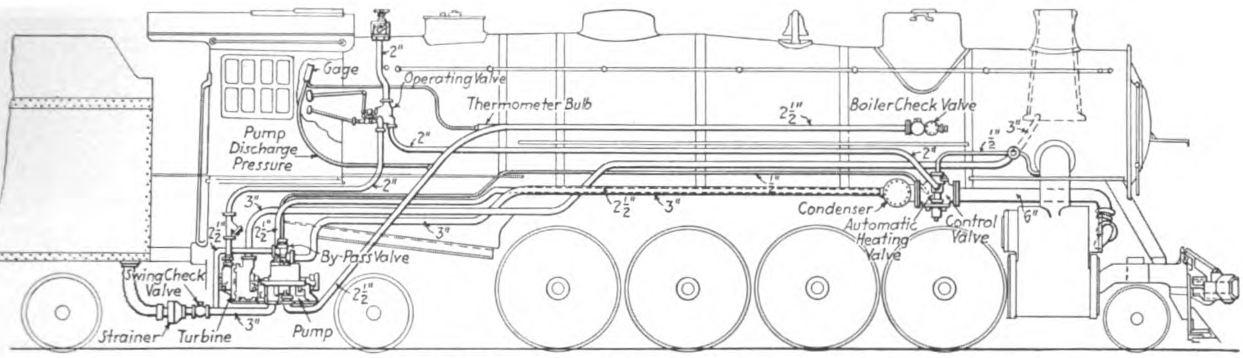
Yoley, high-ductility nickel-copper alloy steel produced by The Youngstown Sheet & Tube Co., was used in the operations. A reduction of 150 lb. per door from the normal weight of box-car doors of comparable-strength carbon steels was achieved. The fabricating company found that the tight hard scale present on sheets of this material does not crack in the forming of the sharper angles.



Box-car doors made by the Youngstown Steel Door Company—Each Yoloy door represents a saving in weight of 150 lb., or 300 lb. per car

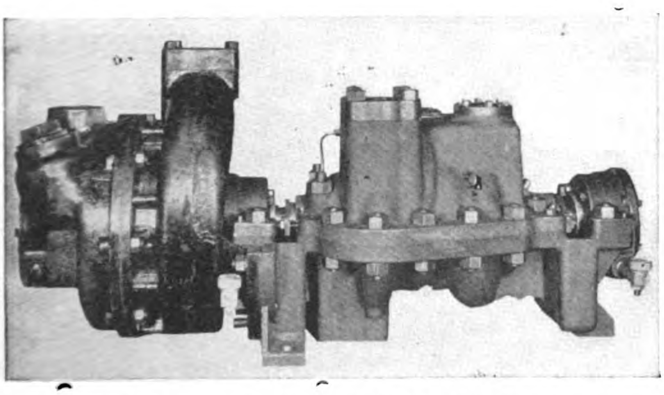
The Hancock Turbo-Injector

A Turbo-Injector system for supplying hot feedwater to locomotive boilers was described at the Western Railway Club feedwater-heating symposium on November 16, 1936, by W. J. Hall of the Consolidated Ashcroft Hancock Company, Inc., the company responsible for the development. The system consists of a four-stage centrifugal pump driven by a steam turbine, a condensing chamber, a combination check valve and control valve, an operating valve, a by-pass valve, and an automatic heating valve.



Installation of the Hancock Turbo-Injector on a locomotive

With this device hot water is fed to a locomotive boiler by pumping the cold water from the locomotive tender through the condensing chamber which contains several nozzles and tubes quite similar to the nozzles and tubes used in a live-steam injector and which, in this device, entrain and mix the exhaust steam with the cold water. Consequently, the Turbo-Injector may generally be classed as an open-type feedwater heater in which the exhaust steam mixes directly with the feedwater. The principle employed which is new to locomotive practice is the use of these nozzles and tubes for entraining exhaust steam from the exhaust passages and for mixing this steam with the water.



The turbine-driven pump unit on the Turbo-Injector system

The various parts of the system function as follows: The steam turbine, which drives the four-stage centrifugal pump, has three stages, is rated at 50 hp., is equipped with a governor and runs at a maximum speed of 5,000 r.p.m.

The pump has four stages which are hydraulically balanced to prevent end thrust. Both the pump and turbine rotors are mounted on a common shaft, and, together with their casings which are bolted together, form the pumping unit. This unit is normally located at the side of the locomotive and directly below the cab.

The condensing chamber consists of a drum-like body having within it several nozzles and tubes much like those used in live-steam injectors. This condensing chamber can be located either at the front end of the locomotives or at the pumping unit or, if more convenient, it can be located anywhere along the side of the boiler. Cold water from the first stage of the pump enters this condensing chamber and in passing through the nozzles and tubes it entrains exhaust steam from the exhaust passages. The resultant hot water is delivered back to the pump through the by-pass valve.

This by-pass valve, which is mounted directly on the pump casing at the suction to the second stage of the pump, is a pressure-loaded check valve. It receives the heated water from the condenser and, dependent upon the speed of the pump, either delivers all of this hot water to the second stage of the pump or by-passes part of it back to the suction of the first stage of the pump. The function of this by-pass valve is to maintain a proportional pressure differential between the cold water delivered to the condenser and the hot water delivered from the condenser. Because of this by-pass valve, the Turbo-Injector maintains a constant delivery temperature at a given exhaust pressure throughout the entire capacity range of the pump. This valve also makes possible the regulation of the capacity of the pump from a maximum down to 30 per cent of that maximum.

The operating valve is to control and to regulate the flow of live steam from the boiler to the steam turbine. This valve is located either inside or outside of the cab within easy reach of the engineman.

The combination check valve and control valve is usually located at the front end of the locomotive and placed between the condensing chamber and the exhaust passages. This valve makes it possible to operate the pump with the locomotive working or drifting or standing. When the locomotive and the pump are both working both valves in this combination valve are open to admit exhaust steam to the condenser. When the pump is not working, but the locomotive is, both of these valves are closed to prevent the exhaust steam from the cylinders flowing back into the pump.

The automatic heating valve, which is bolted directly to the combined check valve and control valve, admits live steam from the boiler to the condensing chamber during the periods when the locomotive is standing or drifting to heat the feedwater under these conditions to a temperature of 200 deg. F. or more. This makes it possible to use this system to feed the locomotive boiler, whether or not the locomotive is working, because it is impossible under any condition to put cold feedwater into the boiler. As its name implies, this valve works automatically and needs no attention what-

soever from the engineman. In addition to the above, a pressure and temperature gage is furnished. The pressure gage indicates the pressure of the water in the delivery pipe so that it is known that water is entering the boiler. The temperature gage indicates the temperature of the water entering the boiler at all times.

The operation of the Turbo-Injector is as follows: With the pump running, the water from the tender flows to the first stage of the pump and is delivered to the nozzles of the condensing chamber. As the water passes through these nozzles and into the condensing-chamber tubes, the exhaust steam from the locomotive cylinders is entrained and the mixture of exhaust steam and water is delivered from the condenser tubes back into the second stage of the pump. As this heated water passes to the second and to the third and then to the fourth stage of the pump, its pressure is built up gradually, so that when the water leaves the fourth stage of the pump it has sufficient pressure to lift the boiler check and discharge into the boiler.

The weight of the Turbo-Injector complete, including the various valves and exclusive of the piping, is 1,300 lb. The pumping unit itself weighs 800 lb. The Turbo-Injector has a maximum capacity of 14,000 gal. per hr., and its capacity can be regulated to any reasonable minimum.

The feedwater temperature attained varies with and depends upon the locomotive exhaust pressure, being approximately 15 deg. below the temperature of saturated steam at a pressure corresponding with the exhaust pressure. For example: Assume a locomotive is running with 10 lb. exhaust pressure. The temperature of saturated steam at 10 lb. pressure is about 240 deg. F. Under this condition it is said that the feedwater from the Turbo-Injector will enter the boiler at approximately 225 deg. F. with the savings in fuel and water related to the temperature rise of the water.

Union Pacific Streamliner Brake Tests

(*Continued from page 159*)

The automatic emergency stop was slightly shorter than the slow service straight-air stop at a similar speed.

Rates of Retardation—Rates of retardation were obtained from accurately plotted speed-time curves made from the record obtained on the instruments in car 3. The individual curves for runs Nos. 1, 6, 10, 12, 14, 20, 21, 22, 24, 25, 32, 35 are shown in the various graphs. The slope of the speed-time curve was used in determining the rates of retardation at various time intervals. The rates of retardation, as obtained on the decelerometer and by records of the brake-cylinder pressure were also used in determining the points at which the retardation changed, as well as maximum and minimum values. The average rate of retardation was about 2.8 m.p.h. per sec. during all of the stops. The tests during which the brake valve remained in service throughout the stop gave higher rates than when the brake valve was lapped. Automatic full service applications resulted in a maximum of 4.2 m.p.h. per sec. Train-control applications gave somewhat higher values, such as 6.5 and 5.7 m.p.h. per sec., respectively, for tests Nos. 20 and 21. When the Decelakron was set at its original values of 2 m.p.h. per sec. for low-pressure service, 2.5 m.p.h. per sec. for high-pressure service, and 3 m.p.h. per sec. for emergency service, the average rate of retardation during the stops was approximately 2.25 m.p.h. per sec. with a maximum of 2.75 m.p.h. per sec. Since the Decelakron was set back to its original value at the end of the tests and prior to placing the train in regular service, these retardation values would be expected to prevail on the train.

Brake-Shoe Temperature and Wear—The maximum brake-shoe temperature recorded was 380 deg. F. The wheel-surface temperature, after the high-speed stops, showed a maximum of 360 deg. F. The records of wheel and shoe temperatures were not taken on all of the tests, and therefore the values just given may have been exceeded on several occasions. The records taken were obtained after high-speed stops, and should represent values which would be expected in service. A small amount of metal was found bonded to the wheels after the high-speed stops, but it was not enough to cause any noticeable roughness.

Wheel Sliding—Accurate observations were not made for wheel sliding during the stops. However, visual observations were made just prior to several of the stops from high speed, and it was noticed that sliding occurred on truck No. 6 for about the last 2 ft. of the stop. The wheel revolution record taken on the lead axle of this truck showed no evidence that the wheel slid during any of the stops. This truck had the highest braking ratio, and therefore it would have been more likely for the wheels of this truck to slide than for those of any other truck. None of the wheels showed any slid-flat spots after the completion of the test run.

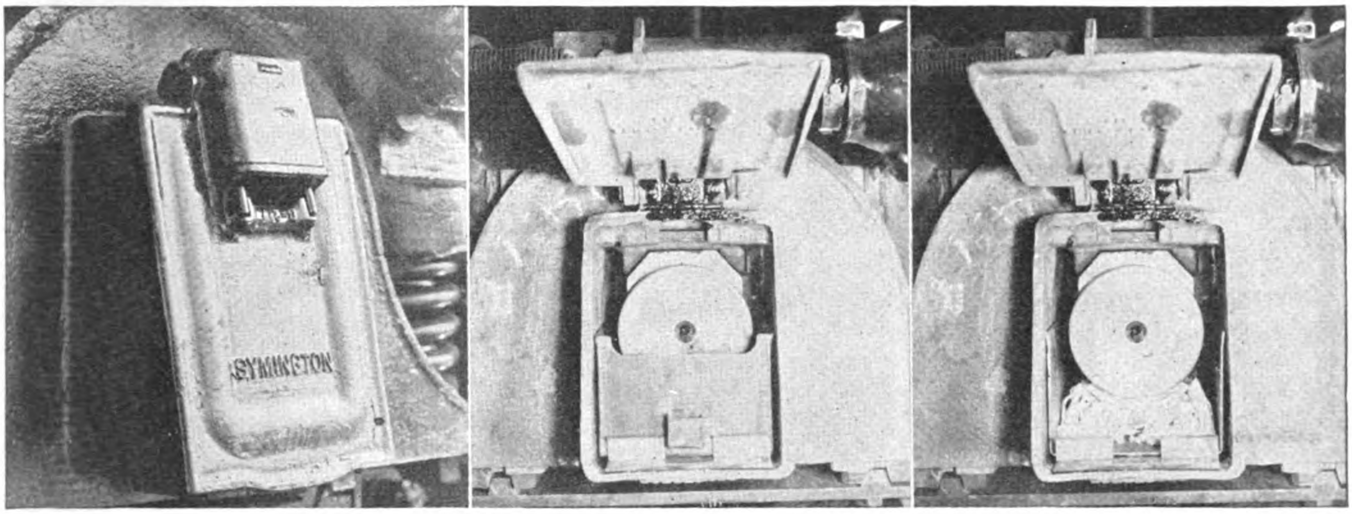
Conclusion

The general functioning of the various parts of the A H S C brake equipment was entirely as intended. The various devices responded quickly and produced the desired results. Stopping distances were within the required range and were considered satisfactory by the Union Pacific representatives present during the tests. The stopping distances compared favorably with those obtained on other high-speed trains in spite of the fact that the brake shoes on the City of San Francisco were not worn in sufficiently to give uniform bearing.

The Decelakron control tended to reduce high rates of deceleration, and in general performed this function satisfactorily. However, on several of the stops, particularly when the Decelakron setting was at the higher values, this device did not entirely prevent the build-up of high retardation rates near the completion of the stop. The tests showed that the highest settings advisable for general operation were 2 m.p.h. per sec. for low-pressure service (under 35-lb. brake cylinder pressure), 2.5 m.p.h. per sec. for high-pressure service (over 35-lb. brake-cylinder pressure), and 3 m.p.h. per sec. for emergency.

A few check tests, made with the control equipment in the cab set for automatic operation, showed that reliable operation could be obtained by this means. The stopping distance with service applications was of course longer than when using straight-air control because of the slower response and reduced brake-cylinder pressures. However, the automatic emergency stop was slightly shorter than the stop made with straight-air service application. The retardation rates near the end of the stops were higher in automatic operation than in straight-air operation because of the lack of Decelakron control. The train-control equipment functioned properly on the two check tests made.

Although the tests were limited to one day, it was possible to make a sufficient number of tests to demonstrate that the general functioning of the A H S C brake equipment under the usual operating conditions was satisfactory, and that the trains containing the equipment could be released for service operation.

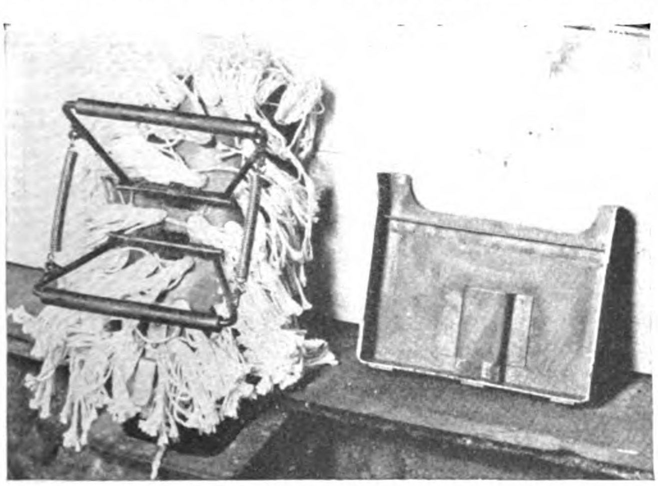


Magnus wick-type journal lubricator as applied to Southern Pacific Daylight train journal—Left: With journal box cover closed—Center: with cover up and the oil box visible—Right: with the end of the oil box cut away to show the lubricating pad

Magnus Wick-Type Journal Lubricator

Substantially higher sustained train speeds have greatly increased the difficulty of maintaining proper car journal lubrication, and to meet this problem, the Magnus Metal Corporation, Chicago, has recently developed a new wick-type journal lubricator, based on the results of extensive tests on the Southern Pacific and designed to give increased lubricating efficiency and lower running temperatures under the most severe modern operating conditions.

The new lubricating device incorporates some rather startling departures from present practice, as it dispenses entirely with the conventional type of packing. The design includes a lubricating wool pad, formed to fit the journal, firmly sewed together into a single piece and fitted into a perforated metal form through which cotton wicks extend down into the oil. The pad and supporting form are held firmly against the bottom of the journal by a spring frame arrangement, as illustrated. The tension of the springs, maintaining a constant pull on the legs of the supporting frame, tends to pull these legs closer together and push the pad higher, thus compensating for wear and holding the pad firmly in contact with the journal, regardless of the jolts occasioned at high speed. Also, dirt, water or other impurities in the box cause no change in the contact of the pad with the journal. The bottom members of the spring frame are equipped with rollers to reduce wear and avoid any possibility of "sticking" in the action of the pad-supporting device.

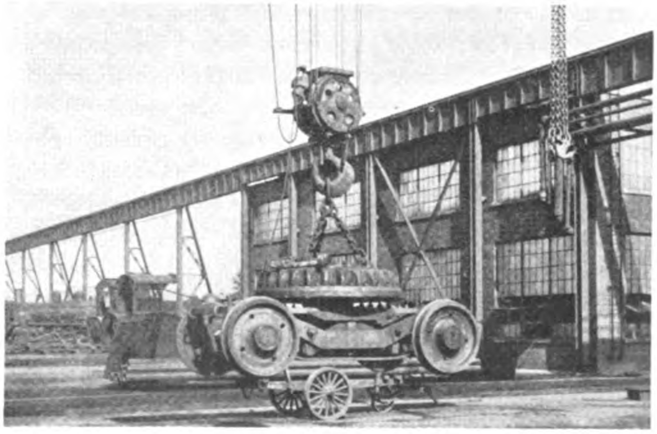


The spring-actuated supporting frame as applied to the lubricator pad—The end of the oil box has been cut away

The lubricating pad is enclosed in a rectangular metal oil box which slides into the journal box and has a felt gasket on the back, making a closure against the journal shoulder. The front of the oil box extends almost up to the center line of the journal and is equipped with an oil level-indicating device. This oil box prevents possible loss of oil as well as contamination of the oil supply with water, dirt and other impurities detrimental to lubrication. Since there is no loose packing to climb the journal, waste grabs and attendant overheated bearings and hot boxes are avoided.

The Magnus journal lubricator is applied to all car journals of the new Southern Pacific "Daylight" streamliner described in this issue of the *Railway Mechanical Engineer*. The design requires a journal box having a square bottom, with a lid covering the entire front of the box. The standard pedestal spacing is maintained. In addition to being applied to passenger equipment, this journal lubricator is adaptable to use on freight equipment. It is also being successfully used in lubricating locomotive engine truck and trailer journals.

* * *



Powerful 50-ton magnet used on the overhead crane outside the Denver shops of the C. B. & Q. for handling heavy parts such as engine trucks, scrap flues, driving wheels and other similar material

EDITORIALS

"Mopping Up" After The Ohio Flood

The courage, resourcefulness and concentrated efforts of railroad men in getting railway shops inundated in the recent Ohio flood back into some semblance of normal operation were nowhere better exemplified than in the case of the Illinois Central shops at Paducah, Ky. Although built with shop and enginehouse floors well above the previous record flood level, water entered the shop on January 23 and rose to a depth of 69½ in. above the shop floor on February 2 and then subsiding but did not leave the shop until February 15. The first members of the reconditioning force arrived in the shop on February 9 and by February 24 a few of the principal machines were ready for operation and locomotive repair work started.

During the flood, locomotives in the shop and enginehouse were inaccessible except by boat, and the turntable could not be operated. The power plant was out of commission, due to water in the basement flooding the coal-conveyor motors and transformers which operate air compressors. Moreover, the city water supply was shut off and water was not available for the boilers, even though the latter, as well as the heavy power-plant machinery, were on a floor above peak water level. Locomotives and machinery in the shops were all or partly submerged and the wood block flooring floated to the top of the water and was distributed throughout the various shop departments. The store-house basement was flooded and the shop yards were, of course, more or less littered with debris after the water had subsided. Shop clerical and payroll records were largely destroyed.

By the execution of plans carefully developed just as soon as the extent of the flood and attendant damage became apparent, some degree of order was attained in spite of these chaotic conditions in the comparatively short period of two weeks, and the shop and terminal reconditioning work was essentially completed five weeks after the water left the shop. On February 7, a train of 14 cars, equipped with a 10-day supply of food and drinking water, as well as a force of 26 men and material such as water pumps, blowers with motors, relief electric blowers, firebrick and other materials, left Chicago, arriving at Fulton, Ky., on February 8. A group of the men was transported by automobile and boat the following day to Paducah shops which still had more than three feet of water over the shop floor.

One of the first jobs was to pump out as soon as possible the power plant basement and provide a supply of fuel and water so that a battery of boilers could be fired up and furnish steam to heat the brick furnaces built to dry out and bake electric motor equipment. Lights and power being cut off entirely, temporary light was obtained for workmen in the basement of the power house by a gasoline motor-driven unit. Electric equipment, such as transformers which furnish power for air compressors and from which the oil had floated out, were then put in operation, also shop and enginehouse power circuits. Some new electric equipment was installed and approximately 525 electric motors were baked out.

Approximately 550 shop machines and furnaces were under water and required attention. It was necessary, in many cases, to disassemble the machines entirely and clean them of all dirt. Other machines, less affected, were cleaned by special pressure guns, forcing the cleaning compound through the machine, this being followed with the proper lubricant. Besides many thousands of dollars worth of company-owned small tools, the personal tools of mechanics that were submerged in water were also passed through the cleaning process. Other tools, such as air drills and air guns were blown out by use of a spray gun, using kerosene mixed with a small amount of lubricant. Some equipment, including electric welders was shipped back to the manufacturers for reconditioning.

Considering the extent of flood damage in this modern railway of the Illinois Central at Paducah shop, the success of mechanical-department forces in getting certain key machines in the shop in operation in less than two weeks after water was out of the shop and practically completing rehabilitation work in a period of five weeks is a notable achievement.

Facts About Machine Tools

There's a well-worn story that has been going the rounds since the early days of automobiles about the owner of a Model T Ford who had a mania for equipping his car with gasoline-saving devices. He was a willing victim for the salesmen of gadgets. As the story goes, he put on one device that saved 25 per cent of the fuel; another that saved 40 per cent; another that saved 20 per cent; another that saved 30 per cent. The result was that he reached a stage where he had to stop every 10 miles and bail out two gallons of gasoline. Ridiculous, you say! Certainly. The average auto-

mobile owner spends more money today for fuel than he did 20 years ago. But he gets a lot more performance for his money because the manufacturers have built performance into modern cars. Similarly, the layman, unacquainted with the development in the art of locomotive design might conceivably inquire why it is that the 30-year-old locomotive had a 10-ton tender while the modern power has a 20-ton tender. What he may not understand is that every one of those twenty tons of fuel on today's locomotive produces more ton-miles faster than can possibly be done by each of the ten tons on the 30-year-old power.

It has been pointed out many times that the problem which a mechanical officer faces in developing and controlling methods for the maintenance of railroad equipment is one so intricate and so varied in all of its ramifications that it is extremely difficult to visualize it as a whole. The builder of locomotives and the manufacturer of locomotive devices places before the railroads his claims that he can save so much money by the use of his product. The manufacturers of passenger- and freight-car materials and specialties offer their products as factors contributing to economies. The producer of machine tools and shop equipment for the back shop and the engine terminal knows that the railroads can save money if they will install modern facilities. The job of the mechanical officer is to consider all of these claims, separate those offering the greatest immediate prospects for economy and then figure out for which of the numerous projects that he would like to carry out he is most likely to be able to compete successfully with the demands of other departments for capital expenditures.

How Much Will a Machine Tool Save?

The subject of equipment maintenance can be discussed endlessly on a general basis without arriving at any solution or even a clear understanding simply because it involves too many varying factors, any combination of which may affect a result adversely. So, it is necessary to be specific. Let's take the subject of machine tools, for example. A mechanical officer does not think entirely in terms of machine tools, for of all the problems that come to him in the course of a day's work less than one out of ten involves machine tools. What he wants to know is: How much will a machine tool save; how much will it cost, and does the saving justify the cost?

If you've got the answer to those questions, in relation to his specific situation, you at least have something in which he is interested. He knows from experience that unless he is able properly to control the factors to which a machine is definitely related the cost of locomotive repairs might increase in spite of marked reductions in the cost of machining locomotive parts. The mechanical officer assumes that the members of his staff—the machine-tool supervisor and the mechanical engineer—and the responsible shop supervision—the shop superintendent, the general foreman and the machine-shop foreman—whose duties require that they be interested in machine tools, in part or as a whole, are well informed as to the possibilities of modern tools. Those are the men to whom the educational and sales efforts of the machine-tool builders must be directed. It is to the builders' representatives that these men must look for the information that enables them to make intelligent recommendations to superior officers.

The indications are at the present moment that the railroad industry is going to represent a market of considerable importance to the builders of machine tools and equipment. There are manufacturers who approach the problem of supplying the railroads with an intelligent understanding. They will profit by that understanding. There are those who feel that, because of an apparent lack of appreciation of the value of their particular products (some of which may not be appreciably better in the railroad shop than the tools now in use), the railroad man is hopelessly set in ways of backwardness and does not want to be helped. To these latter manufacturers the railroad market will be distinctly not worth while.

The Railroads Need New Tools

First, let's get one fact straight. The railroads need modern machine tools. The need does not necessarily arise alone from the fact that many shops contain 20-, 30- or even 40-year-old tools. Many such tools perform only a stand-by service, taking occasional jobs when work becomes temporarily congested at the regularly used machines. The worst that can be said of them is that they occupy floor space. These older and infrequently used tools are not particularly important from the replacement standpoint for a study of the potential economies as a result of replacement would probably indicate that the savings would not justify the change being made. The railroad man, therefore, is not going to be particularly receptive to the suggestion that all old machine tools in his shop be replaced with modern prototypes.

He is, however, vitally interested in any installation that will return to his company a saving of not less than 17 to 20 per cent on the investment. In the case of one road a saving of 26 per cent on the investment was estimated in a group of new tools on the basis of using them 16 hours a day. In spite of the fact that the total machine-hours of this group of tools has today, after a little over a year of use, reached a total of only 42 per cent of the 16-hour-day potential the actual savings have been 19.5 per cent on the investment. The expenditure for the new tools has been justified. It is obvious from this case that the road needed the new tools.

Not long ago we had occasion to visit a newly built industrial plant in the company of the works manager and, when questioned as to the period of time in which the machine tools would be expected to pay for themselves, he replied, "Six years." Why so short a time? Because, these tools will probably be operated 24 hours

a day. Here lies one of the essential differences between an industrial shop and a railroad shop—on an eight-hour shift basis it would take from 17 to 35 years to get the same amount of use from a railroad machine tool. In all too many cases, particularly in relation to production machinery, the tool is obsolete before it has outlived its mechanical usefulness. It is significant that railroad shop men are recognizing the desirability of extending the daily service hours of machine tools in order to get the maximum of serviceability out of the tools before they become obsolete.

This discussion might be carried on indefinitely but it can be profitably concluded at this point by facing one set of facts: that the older machine tools in railroad shops working on the major machining operations can be replaced by modern tools with resultant substantial savings; that a recognition of the fact that specific applications resulting in savings of 17 per cent or more on the investment will get the first consideration; that railroad machine tools must meet the requirements of railroad shop conditions, not those of other industries. The manufacturer who approaches the railroads with an understanding of these basic facts will undoubtedly discover that they are in a receptive mood.

I.C.C.'s Golden Jubilee

The Interstate Commerce Commission celebrated the completion of fifty years of service on March 31, 1937. The Act creating the Commission did not, of course, contemplate the extensive and onerous type of regulation now in effect. No fair-minded person will deny the wisdom and necessity of a certain degree of regulation for the public utilities. Regulation, however, which may have seemed advisable when the railroads competed for business only among themselves and were considered a monoply, is neither necessary nor desirable when other types of common carriers enter the field, and this is particularly true when such other carriers are, in effect, subsidized or are not subjected to comparable regulation. It is important, therefore, in the public interest that the Commission, under the direction of Congress, should construe its power in a much broader light as it enters the second fifty years of its existence. All of which in no way reflects upon much of the excellent work done by those departments of the Commission which come into most intimate contact with the mechanical department—the Bureau of Safety and the Bureau of Locomotive Inspection.

It is interesting to note from the first annual report of the Interstate Commerce Commission, that the railroad mileage of the United States, computed to the close of the fiscal year 1886, was only 133,606. The first report also contains this significant statement: "The railroads provide for the people facilities and conveniences of a business and social nature, which have become altogether indispensable, and the importance of so regulating these that the best results may be had, not by the general public alone, but by the owners of railroad property also, is quite beyond computation." It is to be feared, however, that the Commission has not always kept this objective clearly focused in its mind and that it has sometimes overlooked the interests of the owners. In the last analysis, the best interests of our people will be served only when a proper balance is maintained between the interests of the general public, the owners and the employees.

New Books

TURNING AND BORING PRACTICE. *By Colvin and Stanley. Published by McGraw-Hill Book Company, New York, N. Y. 453 pages, 5½ in. by 9 in. Cloth bound. Price $4.00.*

This book is divided into five sections, covering the fundamental operations of engine lathes, turret and semi-automatic lathes, automatic screw machines, boring machines, and tools for cutting different materials, respectively. The first section, comprising the first seven chapters, is devoted to engine lathes in which the authors discuss the development of the machines and chucks, the chucking of material, turning taper, and thread cutting. The second section, comprising chapters 8, 9 and 10, is devoted to turret and semi-automatic lathes, their construction and uses in production work. Section three, comprising chapters 11 to 17, inclusive, cover setting up and operating automatic screw machines and a description of the various types of automatic screw machines and accessories such as spring collets, feed chucks, taps, dies, forming tools, drills, reamers and recessing tools. Section four, consisting of chapter 18, gives a description of many types of boring machines, including characteristic features and operative functions. Section five, comprising chapters 19 to 24, inclusive, is devoted to a discussion of tools of all types for turning metallic and non-metallic materials. The last chapter discusses coolants and cutting fluids for various machine operations.

LA LOCOMOTIVE ACTUELLE (THE MODERN LOCOMOTIVE). *By R. Vigerie and E. Devernay, Northern Railway of France. Published by Dunod, Paris. 607 pages, 552 illustrations. Price 56.25 francs, paper bound; 66.25 francs, cloth bound.*

This book is based on "Le Mecanicien de Chemin de Fer" by Pierre Guedon, the last edition of which was dated 1920. The book, however, has been practically rewritten and brought up to date. The original mathematical calculations have been retained as these were carefully worked out for the original book by a body of well-known technicians. The book opens with an historical lead followed by a theoretical treatment of the principles involved in steam locomotive design. The various details of a locomotive are then taken up quite fully and covered both descriptively and theoretically. The many illustrations are well chosen.

THE READER'S PAGE

N. & W. 2-6-6-4 Type Articulated Locomotive

To the Editor:

The Norfolk & Western high-speed articulated locomotive described in the October *Railway Mechanical Engineer* is a very remarkable machine, and some even more remarkable figures are quoted in connection with its performance. The record output of 6,300 drawbar horsepower, or one horsepower for each 90.5 lb. of engine weight, is far in advance of anything yet claimed for any other articulated locomotive. The Southern Pacific 4-8-8-2 type locomotives, for example, can develop 5,000 drawbar horsepower at 38 miles per hour.* This is one horsepower for each 123 lb. of engine weight. The 2-6-6-2 type fast freight locomotives built for the Baltimore & Ohio in 1931 have recorded 3,600 drawbar horsepower at 42 miles per hour.† This corresponds to 129 lb. of engine weight per horsepower. It is interesting to note that although the Norfolk & Western locomotive is only 22½ per cent heavier than the Baltimore & Ohio engines, its drawbar pull at speeds of 60 to 65 miles an hour is claimed to be very nearly twice as great.

In your editorial on page 441, some further comparisons are made which present two other locomotives in a more or less unfavorable light. The value of all these comparisons would be enhanced if we knew whether the curves on page 426 represent the output which the N. & W. locomotive is capable of delivering over an extended period of time, or whether they merely depict its momentary maximum performance. By selecting only the high peaks from a series of dynamometer records, without paying particular attention to uniformity of speed and drawbar pull over a sufficient distance in the vicinity of the selected points, it is possible to prepare a drawbar pull-speed curve which may be considerably above the normal capacity of a locomotive. In the absence of any detailed data, it is not possible to say if this has been done in the present case.

Several vital bits of information are missing from your article. What is the water consumption of the N. & W. locomotive when operating at full capacity? How much water can be evaporated in the boiler without resorting to excessive rates of firing? If we may judge from the known performance of other modern articulated locomotives, the N. & W. locomotive can scarcely require less than 19 or 20 lb. of water per drawbar horsepower hour when operating at the cut-off necessary to produce 6,300 horsepower. Assuming the ability of the heater to deliver feed water at the boiling point, the required equivalent evaporation per square foot of evaporative heating surface would be at least 18 lb., which is rather a large order for a boiler with 24-ft. tubes.

Reference is made on page 421, to the speeds attained by this locomotive with very heavy trains. Handling 4,800 tons up a straight grade of 0.5 per cent at 25 miles per hour should present no special difficulty, as it involves the equivalent of 4,800 to 5,000 hp. at the tender drawbar on level track. The hauling of a 7,500-ton train at 64 miles per hour on "comparatively level tangent track" is, however, something entirely different. In this instance, if we assume the drawbar pull to be as shown on the curve on page 426, we arrive at a train-resistance of around 4½ lb. per ton, which is incredible. The obvious answer to this is that the train must have been running downgrade at the time.

W. T. H.

* See Baldwin Locomotives, January, 1930, page 54.
† See Baldwin Locomotives, July, 1932, page 4.

Tool Marks—and Other Things!

To the Editor:

Apropos of F. H. Williams' articles on the finish of fits and the causes of failures, particularly of crank pins, and his theory about these failures; also his suggestion for undercutting to relieve the stresses. Constructive criticism is the soul of progress and the following comments are submitted in this sense.

Any study of a fracture is a post mortem; in other words, anyone can read the pips on dice after they are rolled. A post mortem is held on the material which has failed and if a tool mark is evident, the easiest way out is to let it bear the onus for the failure. Did it ever occur to you that tool marks are a form of close spiral and that it is practically impossible for a fracture to occur except on a tool mark? Has any designing engineer or metallurgist ever called his shot and pointed out in advance where a fracture would occur? I am referring to parts in service and not laboratory specimens.

Agreeing with Mr. Williams for the moment that tool marks are one of the causes for facture, it must also be pointed out that a ground surface, buffed and polished after being ground, will show marks if a microscope of sufficient magnification is used. How far should we carry this? Where shall we draw the line? As a matter of fact, no surface is perfect.

Why are breakages rare on newly built locomotives? Is it because all the parts are in proper alinement? My observation has been that there are plenty of tool marks on the parts of these newly built engines, even when they come from the locomotive builders which specialize on their manufacture. After several shoppings it becomes necessary to renew axles and crank pins. Here and there slight errors caused by wear are ignored for the sake of expediency. Frames may be worn or out of line. The hubs may be worn. The amount of these differences from the original construction may not be much in each instance, but added up, they may be considerable.

Let us consider some of the other factors which may cause breakage. What about rough handling of the locomotive in making up the train, for instance, or the emergency application of the breaks? If a rod bearing runs hot, does the crew put water on it in order not to lose time, or to make up lost time? What about sudden starts on the first moving of a locomotive on a frosty morning? What happens if the rod bushings run too long before renewing, or if there is a lack of lubrication, even for short periods of time? These things are not evident when the fracture is studied in the laboratory.

It is a matter of record that after engines have had

several shoppings, breakages become more frequent. Is it fair then to charge the breakages to tool marks, or is it because the parts may be out of alinement, or have not been properly maintained, so that in conjunction with other factors, such as those mentioned above, the parts finally give way?

Is the designer not at fault in many instances? I know of one class of locomotives on which crank-pin failures were practically eliminated by increasing the diameter of the crank pin by 1/4 in. It is only fair to say that tool marks are still with us on these larger crank pins.

Some of the illustrations used with Mr. Williams' articles show figures or lettering stamped on the finished parts. These stampings are much deeper than ordinary tool marks. Has a fracture ever been traced to them? True, they are not at the most critical points, but surely they could be placed in less prominent places than indicated in Fig. 9, page 61, or Fig. 15 on page 62 of your February number.

My hat is off to Mr. Williams for bringing this subject out into the open. It certainly has started discussion and out of it we may find ways and means of improving our practices, with a view to minimizing failures. I am afraid, however, that he has put all his eggs in one basket, ignoring other sources which contribute to these fractures.

FRANK W. ALWARD

Checking Locomotive Counterbalancing

TO THE EDITOR:

During recent years so much has been written about the counterbalancing of locomotives that further discussion might appear superfluous. There are still, however, one or two points which seem worthy of additional thought.

The advantages to be obtained from transverse balancing, or cross-balancing, have at last been more widely recognized in the United States. Contrary to the belief entertained in some quarters, cross-balancing is not entirely a recent importation from Europe. The principle was well understood and practiced to a limited extent in North America at least half a century ago.* Perhaps if all American railway civil engineers in former years had possessed the same degree of authority and prestige as those of Europe, cross-balancing and a few other refinements of locomotive design might long ago have become the rule, rather than the exception. The design of European locomotives has been strongly influenced by the power of the civil engineer to veto the use of any rolling stock which he considers unduly injurious to the permanent way.

Those who delve into the intricacies of counterbalancing soon find various discrepancies in the methods of applying cross-balancing in vogue in different countries and on different railways. In many cases, cross-balancing is applied to *all* the coupled wheels; in others, only the main driving wheels are so treated. While probably the majority of engineers proceed upon the arbitrary and frequently dubious assumption that from three-fifths to two-thirds of the weight of the main rod may be considered as rotating at the crank-pin, others prefer to expend the time and labor necessary to obtain a more accurate figure. For the sake of "simplifying" matters, quite a number of both European and American engineers are disposed to treat the eccentric cranks as concentrated entirely at the crank pins. European engineers usually make due allowance for the fact that the reciprocating parts and the balance weights move in different planes, but some American authorities assert that this difference is of no consequence. Plausible arguments can be produced in support of any or all of these variations, but the cumulative effect of arbitrary assumptions and disregard of minor disturbances certainly does nothing to improve the balancing of an engine.

The ultimate goal of locomotive counterbalancing is to insure that the revolving parts are perfectly balanced, and that a definite pre-determined proportion of the horizontal disturbance occasioned by the movement of the reciprocating parts is also counteracted by revolving weights in the wheels. Owing to the very nature of driving wheel castings, it is virtually impossible to achieve a correct balance on the basis of calculations alone. What then can be done to provide reasonable assurance that something resembling the desired result will be attained under actual running conditions? The A.A.R. recommended practice for rechecking the main wheel counterbalances of a cross-balanced two-cylinder engine† is, or should be, well-known. The liability to error inherent in this complicated process will be apparent to anyone who studies it carefully. After all the complex mathematics and shop operations are completed, we have a pair of wheels which appears to be correctly balanced when standing in one particular position, but we do *not* know how those wheels will act when revolving several hundred times per minute. If anything approaching a really accurate cross-balance is to be obtained, the old-fashioned balancing ways will have to be superseded by something even better than the device possessing the "important advantage of greater sensitiveness," described on page 41 of your January number.

Some years ago, the necessity of eliminating some of the uncertainty surrounding the practical aspects of locomotive counterbalancing became apparent to the late G. J. Churchward, then head of the mechanical department of the Great Western Railway of England. A so-called "wheel-balancing machine" was thereupon built in the works at Swindon, and similar machines have since been installed in the London & North Eastern works at Doncaster and in the London, Midland & Scottish works at Crewe. Complete descriptions of these machines may be found in several English books and periodicals, so no detailed account is necessary here. They consist essentially of a framework embodying two spring-supported bearings in which a pair of mounted driving wheels can be held and driven through a flexible shaft by an electric motor. Any vibration of the wheels and axle when in motion is absorbed by the coiled springs, which are arranged radially around the bearings. Circular weights to represent the revolving parts and the desired proportion of the reciprocating parts are attached to the crank pins in the proper planes, and the wheels are then rotated at high speed. Violent oscillations usually occur at the first trial and the counterbalance must then be adjusted until steady running of the wheels is attained. Results conservatively described as "surprising" are often obtained with wheels thought to be correctly balanced theoretically. Probably few pairs of American driving wheels would run very smoothly if tested in the manner described.

There might be some difficulty in adapting the English wheel-balancing machines to American requirements, particularly with regard to the drive from the motor to

* See a paper by Francis R. F. Brown, "On the Construction of Canadian Locomotives," in Proceedings of the Institution of Mechanical Engineers, May 1887, page 257.

† See Railway Mechanical Engineer, August 1930, page 453.

the wheels, because of space limitations and the larger weights involved, but surely the ingenuity of American mechanical engineers should be equal to the task.

WM. T. HOECKER

Locomotive Road Tests

TO THE EDITOR:

I would like to see the *Railway Mechanical Engineer* publish more results of dynamometer car road tests of locomotives. I am particularly interested in test results complete enough to reveal the codes employed by the various railroads in making computations on an hourly basis.

The A.S.M.E. Power Test Code for Road Tests for Steam Locomotives, series 1923, par. 66, page 23, states, "Item 104, Duration of test or running time, is the actual time between the start and stop of the test minus the time consumed in stops. Item 104 is to be used in all calculations leading to the expression of results of coal and steam consumption per hour."

This seems to me to overlook periods of drifting, during which the rates of combustion and evaporation are practically the same as when the locomotive is standing. If the profile is such that there is 15 or more minutes of drifting included, considerable difference will be shown in consumptions per hour, horsepower hour, square foot of grate area and heating surface per hour, according to whether running time or working time is used.

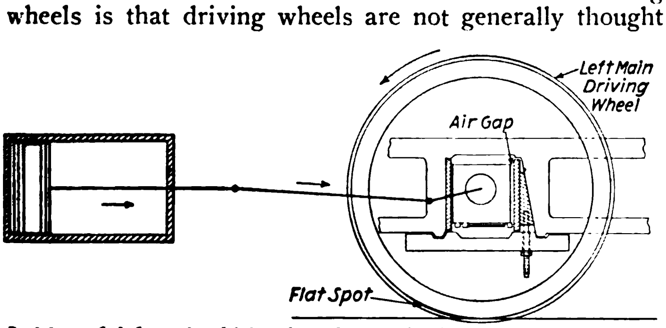
When consumptions on an hourly basis are made on time working, it naturally follows that deductions should be made of coal used for periods of drifting longer than five minutes, the same as outlined in the A.S.M.E. Code, par. 55, for stops longer than five minutes. This practice more nearly approaches test plant conditions, if road tests must be made on territory which is not all level or ascending grades, and disposes of misleading results when an appreciable amount of drifting is included.

INSPECTOR, TEST BUREAU

Flat Driving Wheels Cause Rail Failures

TO THE EDITOR:

On reading reports and discussion of causes of rail failures and other damage to track, I have failed to notice any reference to the effect on rail of out-of-round locomotive driving wheels, which wheel condition is undoubtedly most destructive to rail and track in general, especially since the advent of high-speed trains and locomotives. The probable reason why track and rail failures are not associated with out-of-round driving wheels is that driving wheels are not generally thought of as being out of round. If track men knew the number of locomotives with out-of-round driving wheels that are pounding rails with terrific hammerblows, causing not only rail separation from tie plates, but also kinking and breaking of rails, they would certainly seek means to prevent it.



Position of left main driving box during the back working stroke on the right side of the locomotive—As the left engine begins its back stroke, the air gap is closed causing the box to pound and the wheel to skid, and wear out of round

The writer has studied the subject of rail failures, and the extent to which abnormally worn tires of locomotive driving wheels contribute to it. The result of this study is summarized as follows:

All American railroads but one use right lead locomotives, and therefore this discussion is devoted to such locomotives. Since the adoption of grease for axle lubrication, high running temperatures of driving boxes, and the resulting expansion of these boxes, cause them to pound. The writer has found that this pounding is most noticeable in the left main driving box and that it causes the tire of the left main driving wheel to wear out of round. This out-of-round condition, which as a rule cannot be detected by sight and does not make a clicking sound on the rail such as that caused by wheels worn flat when locked by a driver brake, is formed because the wheel is turning at the same time that it is skidded by the thrust of the left piston. This skidding occurs each time the piston thrust forces the left main driving box against the wedge. The skidding action is accentuated as the size of the air gap, shown in the drawing, is increased.

The position of the left main driving box shown in the drawing, at which position there is an air gap between the driving box and the wedge, is caused by the force exerted by the piston on the right side of the locomotive. This latter force always drives the left main box forward against the shoe at the moment the left piston begins its backward stroke.

T. P. WHELAN.

Value of Proper Machine Finish

TO THE EDITOR:

For the past few months you have been running a series of articles by a man connected with the Canadian National Railways and I have found them very interesting. From the number of complimentary letters in the last *Railway Mechanical Engineer* (Gleanings, December, 1936, issue) I can see that I am not alone in my appreciation.

Something over a year ago (April, 1935) you had an article originating with the Timken people, explaining a method of theirs to reduce breakages on wheel and other press fits, by grooving the hubs to reduce localized stresses. This article was so much to the point that I bought a number of copies for distribution to my friends.

In my own experience I have seen many large shafts —14-in., 16-in. and 18-in. in diameter—broken because of poor machine work or because of corrosion. The users almost invariably blame it on the material; it is almost impossible to convince them that their own sloppy machining is at fault.

I know of a case where a piston rod broke, time and again, where the rod was necked down, with a square shoulder, to go through the piston. This was an almost yearly occurrence and they grew tired of it. They made a new rod with a generous fillet and turned off the square edge of the piston to suit, and in the 20 years they ran the machine, after that, they never had any more trouble.

RICHARD H. WORCESTER.

Gleanings *from the* Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

Obscure Defects in Vital Places

F. H. Williams, in his illustrated articles on locomotive failures, has given us many illustrations of progressive fractures of various parts—parts which are vital in the interests of safe and reliable operation. One cannot but speculate on the damage to life and limb and goods, which may result if such defects are not discovered before the final break occurs. Do you know of any road that specially rewards employees for finding obscure defects before the parts fail? I have been told that at least one railroad formerly paid a bonus for discovering such defects, but unfortunately I have been unable to locate any record of it.

Clubs for Railroad Model Makers

There are upward of 30 good, live-wire Model Railroad Clubs in larger cities, which, beside being ardent boosters for the "big" roads, have open house and periodically have exhibitions that attract thousands of visitors. I know people (I refer to the many thousands who have forgotten that railroads existed) were astounded to see such interest manifested. The result is that all who see these little trains in operation are from then on "railroad minded". I have had the pleasure of explaining the difference between a single and double-sheathed box car, various types of open top cars, why some locomotives have more wheels. Women always ask intelligent questions. There seems to be no end to the interest.

Does It Pay?

Recently one of our machine tools broke down and it was necessary to secure a new part. The maker stated that this particular machine had become obsolete 15 to 20 years ago and that the cost of making the new part would be prohibitive, since the patterns had been destroyed. What am I to do? We can probably find some way of making a new part in our own shops, but naturally it will be costly, although the expense will be absorbed in the general operations and probably lost sight of. The repaired machine cannot, of course, compete with the more modern types, either in output or quality of work. I know that many supervisors in other shops are confronted with the same problem. What are they doing?

Big Men Wanted!

I dropped in at my Alma Mater a short time ago. Things have changed greatly since I was graduated. Among other new stunts I found a Personnel Department. Nowadays they seem all geared up to help the graduates find jobs. I had to fight like the devil to secure one when I was shoved off. The man in charge of the Personnel Department showed me some of the inquiries for men that had come from the industries. Included in these was one from a railroad. Among the basic requisites were good character and family; good size (six feet in height), appearance and personality. It is true the request came from the traffic department, and not from the mechanical department. Maybe they do need size and personality, rather than some other important things that are not quite so evident on the surface. The real jolt—and it is equally true for our mechanical department recruits—was to learn that the starting salary suggested was considerably less than half that paid by other types of business.

Apprentice Yearnings

The editorial, Apprentices on Tour, in your February issue, was sure fine, and I for one wish that I could enjoy an opportunity for such a sound and complete method of learning the trade. The item, "Finished" Apprentices, on your Gleanings page hit me squarely between the eyes. Well, I hardly believed that anyone else could know the feeling a man has in his heart when he has to face a situation like that, unless it was one of those who had had such a really sad experience. **** We have no apprentice instructors, no class work of any kind, just get what we can from the machinists we are working with, or anyone else handy who may have some idea that will prove helpful.

Through the Eyes of an Apprentice

I really feel that our master mechanic is one of the fairest, finest and most considerate gentlemen I have ever known. As I see him passing through the shop most every morning on his way to the office, walking so straight and dignified, even with the burden of his many years, plus the great responsibility of his job resting on his shoulders—still so much at ease in his every movement—it inspires me in my efforts to keep on trying. It stimulates a desire in me to be just like him, to know how to do my work so well that I can meet almost any situation that may arise and handle it efficiently and easily, and do a nice job of it, just as he is and has been doing for a great number of years.

Something to Ponder Over

Personally, I believe too much stress has been laid on the sciences of production. After all, man is more important, and what has been done with him? The man of yesterday was just as good a thinker as the man of today, and he would respond just as quickly. Yet he drove an oxcart, while the man of today drives a high-powered car. Here lies our trouble. The sciences of production have gone far ahead of the development of the men who operate the industries. Man's mind is still back there somewhere, riding along in his oxcart, but his body is going along at 60 miles an hour. The executive today, who handles the destinies of 125 million people, has the same mind, basically, as the first leader of our country. who presided over only a few million people.

Practical Research

I am a graduate of an engineering college and have had some opportunity of studying industrial practices. I have had experience in both college and industrial plant laboratories. With such a background it seems to me that some of our practices on the railroads are crude and inefficient. Consider, for instance, the statement made by Lawrence Richardson of the Boston & Maine, in his recent paper before the New York Railroad Club. "Air hose life is woefully short," he said. "It is surprising to find how few of them are removed on account of aged rubber. Examination of removed hose discloses numbers less than a year old, removed by reason of tearing, particularly at the angle cock nipple. There is a cutting action at the edge of this nipple when hose are not uncoupled in cutting cars." Such conditions are not only costly, but they involve the safety of the train. Surely the railroads would be warranted in making careful and critical researches to determine how such conditions could be improved. Mr. Richardson did indicate that trials are now being made with nipples with rounded edges. When one considers, however, that this air hose difficulty is a chronic condition of long standing, it simply emphasizes our short-sightedness when we get into a rut. This comment is inspired by the item on the Gleanings page of your March number, entitled, Eyes That Do Not See.

With the Car Foremen and Inspectors

Assembly of Reading Gondolas Involves Interesting Methods

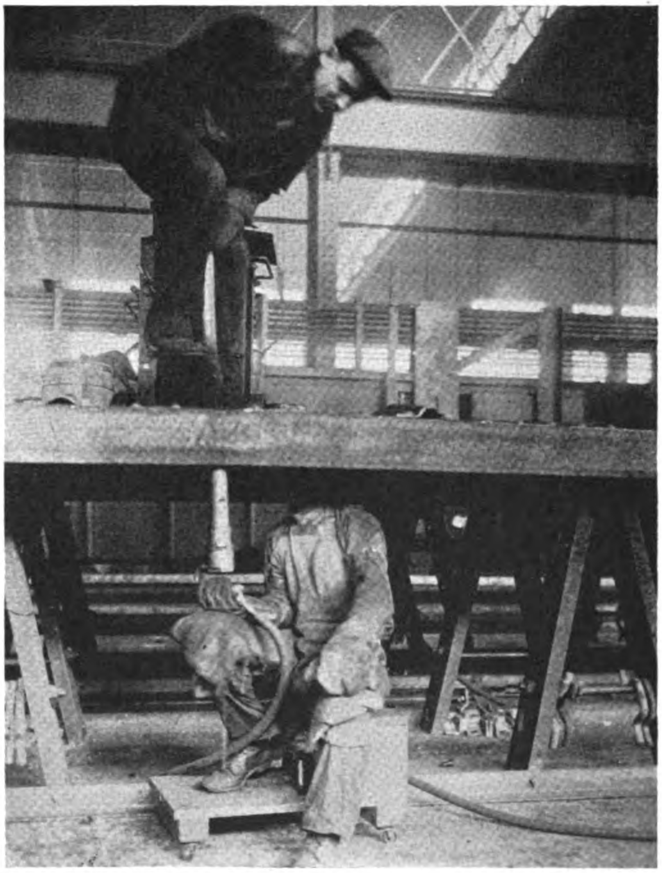
Early last month the Reading turned out of its Reading, Pa., freight-car shop the first of a series of 200, 65 ft. 6 in. steel drop-end gondolas. The principal dimensions of these cars are shown in the accompanying table. The underframes are of all welded construction having center sills composed of 10-in. ship channels weighing 25.3 lb. per ft. These underframes are designed for the Duryea cushion gear. The sides of the car are of $\frac{5}{16}$-in. carbon steel with $\frac{5}{16}$-in. pressed side stakes and collapsible inside stae pockets. Each car side consists of a center section sheet and two end sections making up the 65 ft. 6 in. complete side. The joints between the end and center sections are so designed that a side stake, with inside butt strap, forms the connection. The top rail consists of a 5-in. 19.3 lb. per ft. bulb angle. The floor angle is 3 in. by 3 in. by $\frac{3}{8}$ in. and the side sill angles are 6 in. by 4 in. by $\frac{5}{8}$ in. Fabricated welded end gates are used on these cars. The floor is of $2\frac{3}{4}$-in. oak. Other equipment on these cars consists of Type E bottom-operated couplers, Westinghouse Type AB brake equipment, Ajax hand brakes, four-wheel trucks with cast-seel integral box side frames, 6-in. by 11-in. journal axles and 33-in. multiple-wear rolled-steel wheels. The truck springs are double coil, six nest, having one Cardwell-Westinghouse friction spring in each nest.

These cars are assembled at five spot positions on tracks 5 and 6 of the freight-car shop, a layout of which was published on page 157 of the April, 1936, issue of the *Railway Mechanical Engineer* in connection with the operations on another type of car which was going through the shop at that time. The accompanying illustrations show the details of many of the various steps in the assembly of these cars. The trucks are assembled at an especially set-up position where the handling facilities were such as to enable the work to be carried on rapidly and without interference with the other construction work.

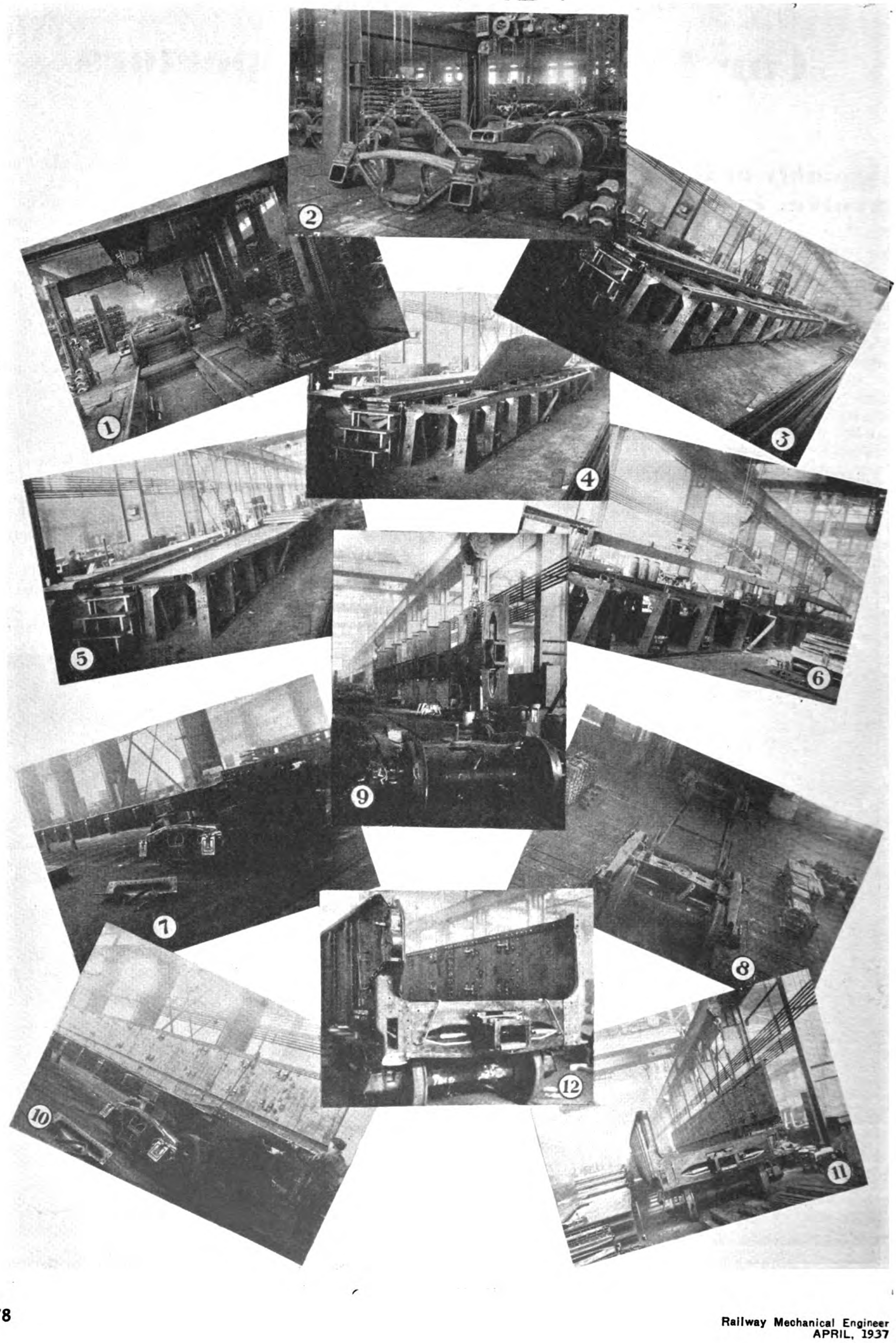
As may be seen from the illustrations, the truck assembly job is set up on a production basis. A pair of wheels with wooden spacers and the truck bolster are rolled into position under an electric hoist operating longitudinally over the track where the trucks are assembled. The side frames are lifted by electric hoists from storage space at each side and are placed with the journal brasses on the journals. The application of the springs, spring planks and truck brake rigging complete the assembly of the trucks. After assembly the trucks are delivered to the body assembly track.

One of the major operations involved in the construc-

Material for the car sides is placed, in the proper quantity for immediate use, at a position adjacent to the assembly jigs



The rivet heaters are on top of the car side on the jig and the riveters work on movable dollies from underneath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tion of these cars is the fabricating of the car sides. This is done at the first of the five spots on special jigs so designed as to accommodate four complete car sides. The entire operation of assembly is planned in such a manner as to produce four finished cars for each eight-hour working day. The job of assembling the car sides on

Principal Dimensions of Reading Steel Drop-End Gondolas

Length, inside, ft. and in.	65– 6⅛
Width, inside, ft. and in.	7– 9
Height of side above floor, ft. and in.	3– 6
Length over end sills, ft. and in.	66– 1½
Length, coupled, ft. and in.	70–10¼
Width, over hand brake, ft. and in.	8–11⅝
Height from rail to bottom of side, ft. and in.	1– 4⅛
Height from rail to top of floor, ft. and in.	3– 9⅝
Height from rail to top of side, ft. and in.	7– 3⅝
Truck centers, ft. and in.	56– 7
Truck wheel base, ft. and in.	5– 8
Total wheel base, ft. and in.	62– 3
Capacity, nominal, lb.	140,000
Capacity, cu. ft. (level full)	1,777
Light weight (sample car) lb.	63,300
Load limit, lb.	146,700
Ratio light weight to load limit	1 to 2.32
Minimum radius curve, ft. and in.	150– 0

the jigs consists of assembling the center and end section side sheets, side stakes, top and bottom side angles, floor angles, butt straps and collapsible side stake pockets.

Unlike some assembly operations of its kind, these sides are fabricated in a horizontal position on the jigs with the rivet heaters working on top of the car side and the

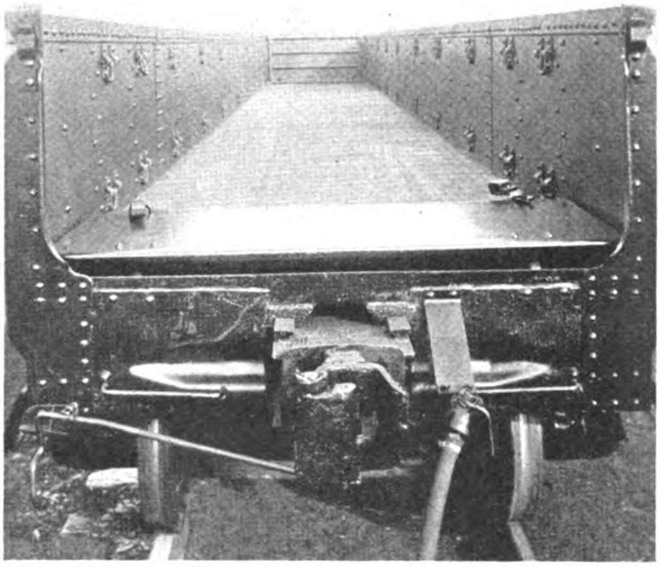
The twelve pictures on the opposite page show the more important stages of the assembly operation. Nos. 1 and 2—The trucks being assembled. Overhead electric hoists are used to handle the truck parts after the wheels and bolsters are rolled into position. Nos. 3, 4 and 5, respectively—The car side assembly jig; one of the center section side sheets being placed in position on the jig; a car side on the jig ready for riveting. No. 6—The completed side being lifted off the jig for placement at the proper spot for assembly. Nos. 7, 8 and 9—Three stages of the operation of placing the underframe on the trucks ready for the sides. Nos. 10 and 11—The sides being set in position ready for riveting to the underframe. No. 12—The end construction of the car.

riveters working from underneath. An unusual feature of this riveting operation is a dolly truck of special design for the riveters. This dolly truck permits the riveters to sit down at their work, moving from one location to another on the floor by means of casters on the dolly. The riveter uses the riveting hammer in a vertical position, the weight of the hammer being held on his knee on special pads provided for the purpose. In each of these car sides there are 857 rivets.

At the second spot in the assembly operation the sides are fitted to the underframe which previously has been placed on the assembled trucks.

When the sides are placed on the underframe at this point in the assembly operation, they are held in place prior to riveting by special fitting bolts and a special design of yoke clamp is used at the end sill position at either end of the car to pull the side up against the underframe for riveting.

At this spot the couplers, grab irons, corner posts, brake forgings and brake equipment are applied. The four cars then move to the third spot where all parts applied at the second spot are riveted up. At the fourth spot the flooring is applied, hand and air brakes adjusted and tested, end gates put on, card boards and defect card holders applied, hand-brake wheels, and bell cranks are applied. The floor is held to the underframe by 440 ½-in. by 3 ⅝-in. bolts; the holes for which are drilled in the floor by the use of templates and the nuts



The completed car showing the arrangement of the end doors and interior fittings

on the floor bolts are pulled up by the use of impact wrenches. After the floor is laid cement is used around the joints at the car sides. All contacting metal surfaces are coated with car cement as well as the entire underframe.

This completes the work at the four spots inside the shop building. The car is then moved outside to the painting position. A coat of car cement has previously been applied to underframes and interior of car while the cars are inside the shop. Just before the cars leave the shop for the painting position they are thoroughly washed to remove all traces of grease, etc. The painting operations consume four days at the fifth or painting spot position outside the shop. On the first of these four days a coat of red lead is applied. On the second and third days, respectively, the first and second color coats are applied. The fourth day is taken up with stenciling.

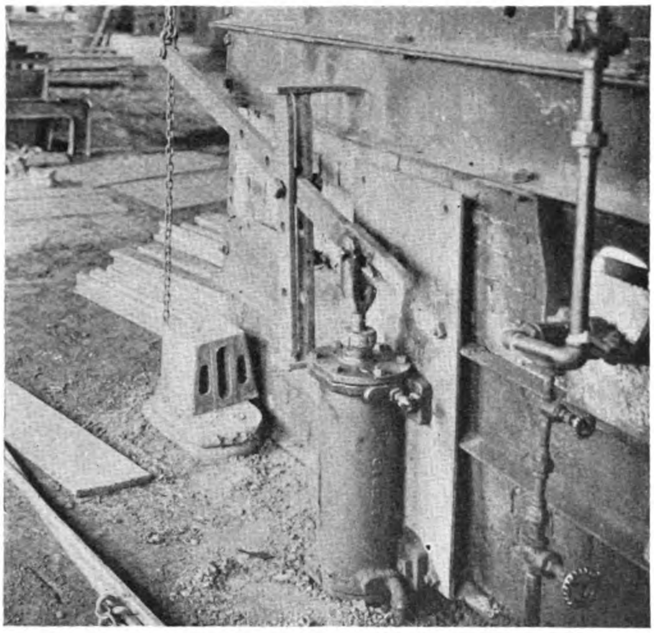
In order to keep the working space between and adjacent to the active tracks on the assembly line clear, a minimum amount of material is placed at the assembly locations. Generally, material of any particular kind is spotted at these locations only in quantities sufficient for eight hours work, these unit-material-supply locations being replenished on the second trick each day.

Air-Operated Furnace Door

By A. Skinner

On a large furnace used to heat heavy forgings, the door was too heavy to be operated by manual labor, and it was necessary to provide some method whereby the door could be operated by power. An ash-pan cylinder was accordingly bolted to a steel plate and both bolted to the side of the furnace, as shown in one of the illustrations.

Referring to this illustration, it will be observed that the fulcrum, made from two pieces of ½-in. by 2-in. flat iron, is supported by two horizontal pieces welded to the top and the bottom and then welded to the side of the furnace. The operating lever has a 1-in. by 6-in.

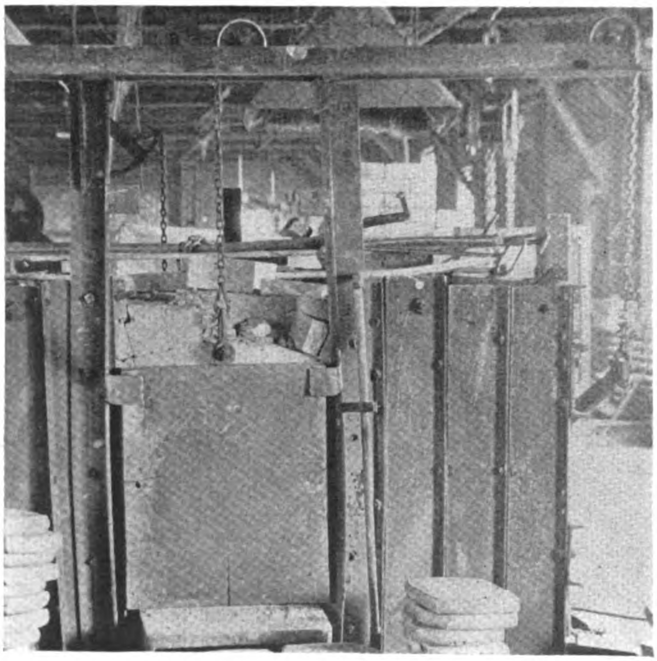


Ash-pan cylinder used in operating a furnace door

slotted hole in one end, connected to the push rod of the cylinder, and the other end is connected to a chain which passes over two pulleys in front of the furnace and is attached to a U-bolt on the furnace door, as shown in the other illustration.

On the front of the furnace at the top are two 3-in. channels with a 1-in. space between them in which the pulleys revolve. The two vertical angles are welded to the top channels and bolted to castings on the furnace. Two flat pieces welded on either side of the door serve to guide the door while it is being moved up or down.

The operating valve is a ¾-in. straight air valve, located convenient to the operator who can readily raise or lower the furnace door by simply moving the straight air valve handle. It was found after piping the valve that the pressure was too great, so the union under the brake valve was filled with babbitt, faced off smooth and drilled with a ⅜-in. hole which choked the pressure



Heavy furnace door as equipped for air operation

down and enabled the door movement to be more easily controlled. This power-operated door has proved very satisfactory, since it saves considerable manual labor and permits one man to operate the door while charging the furnace.

Preventing Moisture in Double-Pane Windows

Shortly after the New York, New Haven & Hartford placed a number of streamline coaches in service about three years ago some difficulty was experienced with the double pane window sash fogging as a result of the

Fig. 1—Grinding the edges of the glass

accumulation of moisture between the panes. After considerable study the method described in this article was developed by the New Haven mechanical department, in collaboration with the engineering department of the Pittsburgh Plate Glass Co.

The sash used in these de luxe coaches consists of aluminum or stainless steel frames with double panes of high grade polished plate glass set in rubber sealing gaskets. The illustrations show the more important operations and facilities used in preparing the parts and assembling and testing the sash.

The selection of perfect plate glass is of primary importance. This having been done the panes are taken to a cutting table, which is covered with felt, and are cut to a template held to the pane by nine rubber vacuum cups. The cutting is performed in such a manner that the edges of the panes are left with perfectly square corners, without any flaking.

Next, the panes are taken to a grinder where the edges

are ground on an edging wheel with the assistance of water and fine, pure silica sand. This operation is shown in Fig. 1. After grinding, the panes are placed in an adjacent rack for washing. In order that the surface of the panes will not be scratched by any sand remaining from the grinding operation they are washed with a finely-atomized spray of air and water.

The next operation, a most important one, is that of matching pairs of panes in order that the total distance through the two panes and the sealing gaskets will be uniform when placed in the metal sash frame. The panes are measured for thickness, with a micrometer, at four corner locations. The minimum thickness is .237 in. and the maximum is .250 in. After matching the panes are placed on a specially-designed cleaning table shown at the left in Fig. 2. This table consists of a

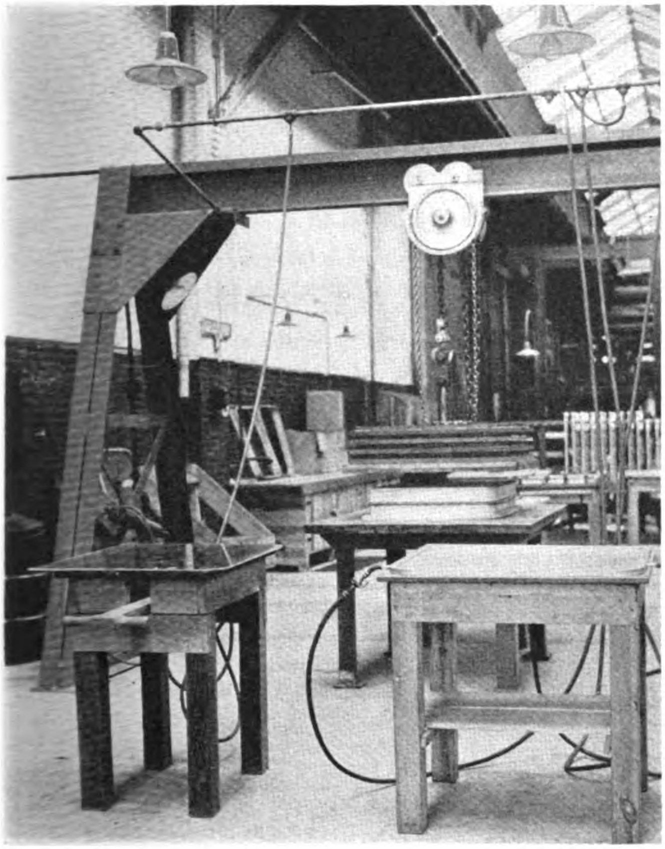


Fig. 2—The section where the panes are cleaned and assembled

felt-padded top with an open center. Within the table is a handling device consisting of an 11-in. diam. vacuum cup on a rotating base. When the polishing of the upper-surface of the pane has been completed, using Bon Ami, the handling device is lifted, by two men, so that the vacuum cup comes in contact with the uncleaned under surface. The vacuum cup is connected to a shop vacuum line, serving this department only, in which a vacuum of about 23 in. is maintained by a small motor-driven pump. By means of the vacuum device the pane of glass is turned over and the other side polished.

The matched pair of polished panes is now ready for assembly in the sash frame. The glass is sealed in the frame by means of rubber gaskets, one around the outside of the glass next to the metal frame and one between the panes. The gasket between the panes is of special rubber of approximately ¼-in. square section and of the same outside dimensions as the pane. In order that this sealing gasket remains flush with the outside edge of the glass it is assembled in a special

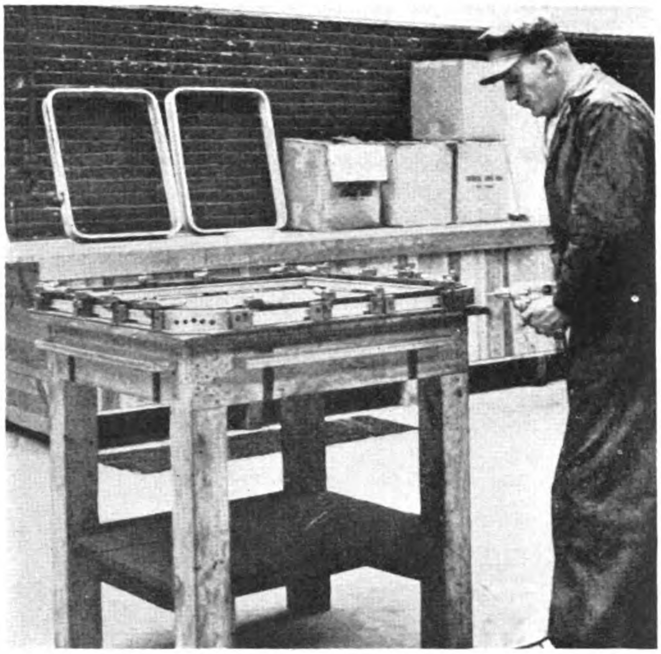


Fig. 3—Workman drilling the holes for the corner brackets by means of a jig

frame which has connections to the vacuum line. This frame, by suction, holds the gasket in place while the glass is placed on either side of it. This vacuum frame is shown in the right foreground of Fig. 2.

The next step is to place the panes in the metal sash frame. This is done with the aid of a special holder shown on the table in the background in Fig. 2. A 2,000-lb. weight is brought over the table by the trolley hoist and lowered onto the assembled sash. This weight compresses the sealing gasket between the panes so that the final space between the panes is about .010 in. less than the original thickness of the gasket. The locking section of the metal sash is applied after the compressing operation is finished.

The assembled sash is now placed in the drilling jig, shown in Fig. 3 where the holes for the corner brackets are drilled and tapped. This corner bracket contains two special nipples used for making connection to the nitrogen gas lines used in the dehydrating operation. While

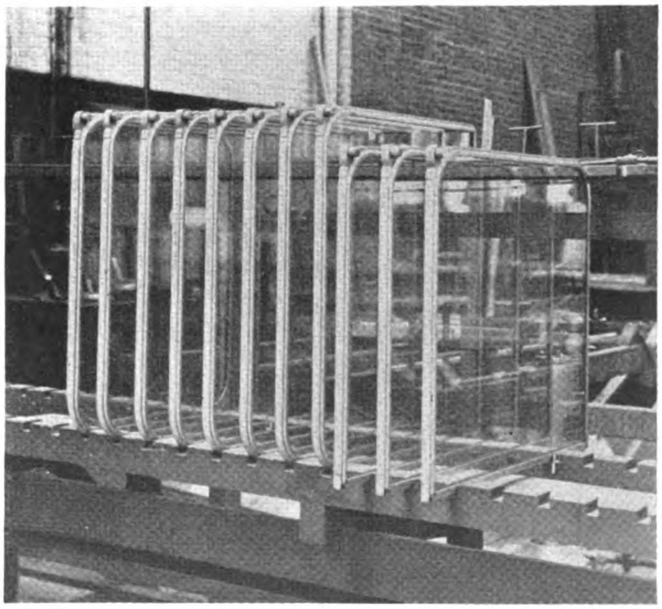


Fig. 4—Finished sash in the dehydrating rack

the sash is in the jig small holes are burned through the rubber separator gasket for these nipples. The corner brackets are applied and the finished sash are placed in the dehydrating rack where nitrogen gas is pumped through the space between the panes for about 12 hours or until frost will not form on the inside of the panes at an outside temperature of 49 deg. below zero. This is determined by applying a Dry Ice pad to the outside of the panes. A special dryer, using activated aluminum, is used in the gas line to remove the moisture. A moisture indicating device is also used so that the test operator may know at all times that the gas is perfectly dry.

After the dehydrating operation is finished a dehydrating cap, filled with activated aluminum, is placed on the corner bracket, over the nipples, to prevent the entrance of moisture into the sash.

Checking Coupler Anti-Creep Feature

In Mechanical Division Circular D.V.-899, recently issued by the secretary, attention is called to the necessity of checking the anti-creep feature of top-operated Type-D couplers and following the proper procedure in cor-

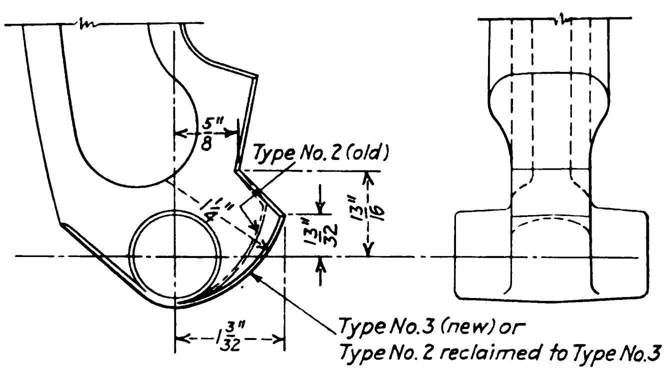


Fig. 1—A.A.R. Type D coupler top lock lifters, new No. 3 type and reclaimed No. 2 type

recting any faulty condition which may be discovered. The following recommendations are made for:

Checking Anti-Creep Feature.—Attempt to lift the lock by pressing downward on a small bar inserted through the front face of the coupler and underneath the lock.

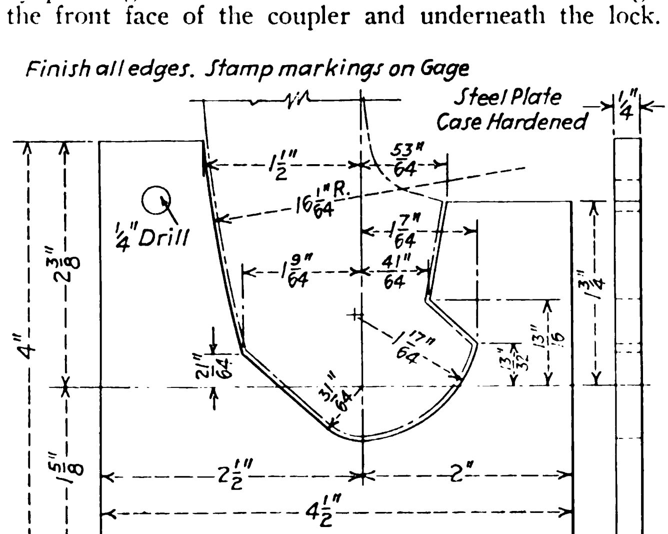


Fig. 2—Gage for reclaiming Type-D coupler No. 2 top lock lifter to No. 3 type

If the lock does not respond to these efforts, the anti-creep feature may be considered to function satisfactorily. If the lock can be lifted by this means sufficiently to release the knuckle, the anti-creep feature does not function properly and should be corrected.

Correcting Ineffective Anti-Creep Condition.—When it is indicated that the anti-creep feature should be improved, it is recommended that a No. 3 Type-D lock lifter, conforming to the design shown in Fig. 1, be applied. If the coupler is fitted with a No. 2 type top lock lifter, this lifter may be reclaimed by building up on the anti-creep ledge to conform with the gage shown as Fig. 2. If the coupler is fitted with No. 1 type of lock lifter, it must be replaced with a new No. 3 lifter or a reclaimed No. 2 lifter.

When a No. 3 or a reclaimed No. 2 top lock lifter has been applied to a coupler, the anti-creep feature should again be tested and the coupler should be fully checked for complete operation.

Questions and Answers On the AB Brake

135—*Q.—Is this downward pressure constant?* A.—No. When the quick-action chamber is charged, the pressure in the emergency slide-valve chamber holds the slide valve to its seat, and pressure on both sides of the strut diaphragm is the same. This has the effect of removing the downward strut pressure, except for the strut spring.

136—*Q.—In full release and charging position, is the brake cylinder connected directly to the retaining valve?* A.—No. It is connected through a passage to the open in-shot valve, from there through passages to cavity *B* in the service slide valve, and through passage *Ex* to the retaining valve.

137—*Q.—How is the in-shot piston volume connected at this time?* A.—Through a port to cavity *K* in the emergency slide valve, thence through a port and passage to cavity *B* in the service slide valve, which is connected to the retaining valve via passage *Ex.*

138—*Q.—What pressures do the spill-over check valve separate?* A.—Emergency-reservoir pressure (above), and the pressure on emergency slide-valve and in the quick-action chamber (beneath).

139—*Q.—In what event do these valves play an important part?* A.—In case the quick-action chamber becomes overcharged.

140—*Q.—When is this likely to occur?* A.—When improper use of the release position of the automatic brake valve is made, and happens on the front end of a long freight train.

141—*Q.—Explain what happens in this event.* A.—When the pressure in the quick-action chamber becomes slightly higher than the emergency-reservoir pressure, the spill-over checks unseat, permitting the overcharge to flow to the emergency reservoir.

142—*Q.—What undesired operation does this movement prevent?* A.—It prevents the quick-action chamber from building up sufficiently to produce an emergency application through the undesired operation of the emergency portion.

143—*Q.—What safeguards are used to prevent the quick-action chamber from being charged from the emergency reservoir?* A.—The use of a spring-loaded check valve and ball check provides double protection against this eventuality.

144—*Q.—What is the state of the accelerated-release*

piston during full release and charging? A.—It is in a balanced position.

145—*Q.—Explain this.* A.—Air from the quick-action chamber is connected through a port in the emergency slide to a passage leading to the left of the accelerated-release piston. Since, the right-hand side of the piston is exposed to the same pressure, the piston is balanced.

Sterling Air-Driven Speed-Bloc Sander

The Sterling Products Company, Detroit, Mich., manufacturer of the Sterling Speed-Bloc Sander, announces a new and improved air-driven model which has been developed through experimental work and practical tests in a large number of plants, using from one to over 150 Sterling sanders regularly in service. The weight of the new model has been reduced from 7½ lb. to 5½ lb. and it is very compact in size, being 7 in. long by 4¾ in. high and 3¾ in. wide.

The Sterling air motor is of patented design, built to close tolerances. Rigid specifications as regards quality of material and workmanship tend to assure continuous trouble-free service and the complete interchangeability of replacement parts required promotes both low maintenance and low operating costs. The machine is said to operate efficiently on 45 to 60 lb. of air pressure.

The cam, fly wheel and connecting rod of the tool are supported on double-shielded ball bearings and all moving parts are of alloy steel, hardened and ground.

For wet work, a water connection is provided for attachment of the water hose. An outlet on either side of the machine directs a spray of water, which is readily adjustable to the job requirement, to the surface being sanded. Re-design of the water outlet protects the workman from getting wet without the use of baffle plates. For work with naphtha, benzine, etc., a special block with Sterlite base is provided which is impervious to volatile compounds.

The principle of "Floating Power," as applied to the construction of the bloc and pad, is an exclusive feature, providing flexibility for sanding and rubbing of curved and flat surfaces. Special pads, varying in flexibility, have been developed for particular types of surfaces and materials. The sanding action is reciprocating, with ⅝-in. travel of the pad, at speeds of 1,750 to 3,000 complete oscillations per minute, dependent upon the application. This movement duplicates the natural back-and-forth action of hand sanding.

This Speed-Bloc sander has many possible uses in railway car shops and, to a somewhat less extent, in locomotive shops where tank exteriors must be sanded as well as many other metal parts. From one to five sheets of abrasives may be attached to the sanding pad at one loading. Ordinary sized sheets are cut into three pieces without waste, each 2⅔ in. by 9 in.

Improved 20-Ton Empty Car Jack

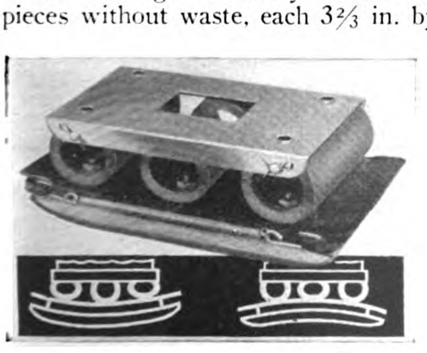
Early in February, Templeton, Kenly & Company, Chicago, started production on an improved 20-ton empty car jack which is shown in the illustration set up ready for jacking a car. This new heavy-duty jack, known as the Simplex No. 2029, is featured by unusual ease of operation, combined with ruggedness and safety. The jack is single-acting with provision for automatically raising or lowering the load, notch by notch. Operation occurs only on the downward or effective stroke of the

Simplex empty car jack as used in jacking a car

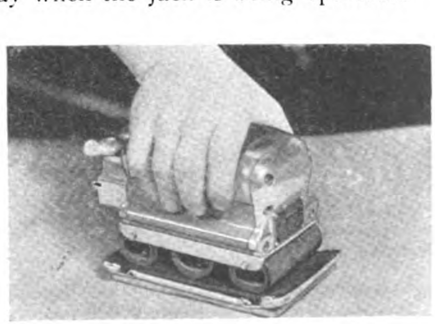
lever and the rack bar cannot be tripped while under load.

Standard Simplex mechanism, used in the new jack, includes triple tooth pawls and a rack bar made of a heat-treated chrome nickel steel forging. The trunnions are said to be unbreakable and there are no fulcrum pins. All parts, designed for maximum simplicity, are wear- and corrosion-resistant. The base of the jack has a large area and is arched for stability and strength. A 3-in. by 5-in. auxiliary toe-lift shoe is provided for use where necessary at a small extra charge. The jack is furnished with a 6-ft. oval second-growth hickory lever pole, an oval pole being preferred because it is somewhat larger in cross-sectional area and cannot be inserted across the grain.

The jack has a capacity of 20 tons, a height of 28½ in., a lift of 18 in. and a weight of 100 lb. It is easily handled with the new type of carrying handles which drop out of the way when the jack is being operated.



General construction and method of using the improved Sterling air-driven Speed-Bloc sander



IN THE BACK SHOP AND ENGINEHOUSE

An Interesting Method of Setting Valve Gears

As a result of an attempt to adapt the principles of setting Walschaert valve gear described in the December, 1926, issue of the *Railway Mechanical Engineer* to conditions existing in the West Albany shops of the New York Central the supervisors in charge of valve setting at that shop developed a procedure for setting both Walschaert and Baker gears which is different from general practice. After the method was fully developed it was found that valves gave equal steam distribution and permitted setting the valves in a minimum of time and, therefore, it was adopted as standard practice on the New York Central. This method requires that all motion work, with the exception of the eccentric rod, be made to conform to blue print dimensions because the accuracy of the method depends upon maintaining correct dimensions of all valve-gear parts.

In developing the method for setting valve gears, the gear of each class of power was laid out on a drawing in the office of the mechanical engineer, using the correct dimensions of all motion parts. After the gear was laid out, the correct valve travel by crank setting was obtained. Then the eccentric-rod length was determined which would give equal displacement of the valve on each side of its mid-position. Tracings were then made of the Walschaert gear and the Baker gear on which were given instructions for setting the valves, and also the travel of the pin in the link foot, the travel of this pin in front of its mid-position, and the travel of this pin in back of its mid-position, together with other dimensions of motion work taken from standard prints of the two types of valve gears. Tables I and II give these dimensions for one class of power on the New York Central System equipped with Walschaert valve gear, and one class of power equipped with Baker valve gear, respectively. These two classes of power were chosen for inclusion in this article as examples of the tables on the aforementioned tracings, and to illustrate the method of setting valve gears as developed at the West Albany shops.

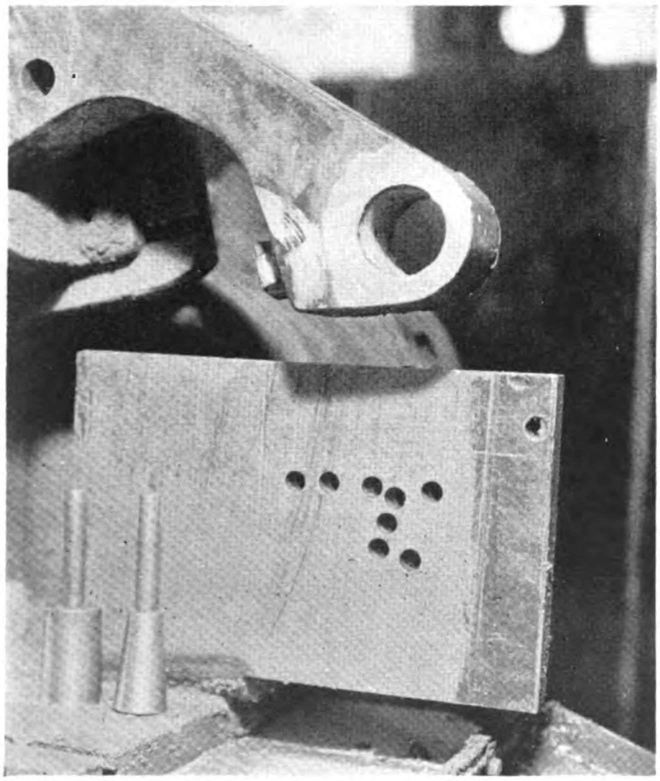


Fig. 1—Angle plate for locating link to proper back set of foot preparatory to grinding

Setting the Walschaert Valve Gear

Since the accuracy of the method of setting valve gears herein described depends upon restoring all motion work to correct blueprint dimensions, the motion work is delivered to the machine shop where it is inspected, worn parts built up, and all parts are restored to standard dimensions. Radius rods, combination levers, and union links are checked for length and corrected if found in error. The bolt holes in the link body and link cheeks are welded if oversize, and the links are ground to restore the correct back set to the link foot. All link work is done with the aid of a jig; the procedure for using the jig varies slightly, however, depending on whether the link foot is an extension of the link body or an extension of one of the link cheeks.

Consider first a link on which the link foot is an extension of the link body. At the West Albany shops a cone-shaped plug is placed in the link slot, and with this plug in place the link is mounted on the pendulum head of the grinder with a pin extension from the cone plug fitting into a hole in the center of the pendulum head, thus leaving the link free to revolve and to move back and forth on the plug. Another cone-shaped plug with a pin extension is placed in the eccentric-rod-pin hole in the link foot. This pin extension is placed in one of a number of holes drilled in an angle plate, shown in Fig. 1, which is fastened to the bed of the grinder. Each of these holes is for a different class locomotive. When the cone plug is placed in the link-foot hole, but with its pin extension set flush against the face of the angle plate, the link can be revolved and moved on the cone plug in the link slot until the pin extension from the plug in the link foot is opposite the hole in the angle plate which corresponds to the hole for the class of power from which the link was dismantled. The pin extension from the plug in the link-foot hole is then inserted in the hole in the angle plate. With the two cone plugs in position, the link cannot move further and is in a position which assures that the link will be ground with the correct back set of the link foot, the holes in the angle plate being located to give this result. With the two cone plugs holding the link in position, the link is clamped to the pendulum head and the plugs are removed. The link is then ground. Fig. 2 is a view of a link in the process of being ground on the pendulum grinder.

After the link is ground, the link block is fitted and placed in the link slot. The link is then mounted in the jig shown in Fig. 3. This jig has two tapered adjustable rests upon which the link is placed. A pin is inserted in the link block, and bushings representing link trunnions are placed on the pin. These trunnions are bolted

in V slots, leaving the link free to revolve and to move on the link block. A cone plug is placed in the link-foot hole, and a pin is inserted through the cone plug into one of a number of holes in the channel base of the jig, each hole being laid out for a different class of power equipped with Walschaert valve gear. With the trunnion pin and link-foot pin in place, the link cannot move further. The tapered adjustable rests beneath the link are then run up against the underside of the link body and the link is clamped in this position by set screws on the top of the link body. The pin through the link-block hole is then removed and the link-cheek plates are clamped in their proper location central on the link body. If it had been necessary to weld up the link and cheek holes, new holes are laid out according to blueprint dimensions and the jig with the link in place is delivered to the drill press. When the holes are drilled, they are reamed, and fitted bolts are applied. The links and other motion work are then delivered to the erecting floor.

Consider now a link on which the link foot is an extension of one of the link cheeks. After dismantling the link it is placed on the grinder up and ground to blueprint dimensions. After grinding, the link block is fitted and placed in the link jig where the trunnion pin of the link jig is passed through the link-block hole. A setting-up plate with the correct link-foot back set is clamped to the link body, and the cone plug and pin arrangement for the eccentric-rod-pin hole is inserted in the link foot and the hole in the channel base of the jig which corresponds to the class of power from which the link was dismantled. The link body is then set in the jig on the tapered adjustable blocks and the link is locked in this position. The setting-up plate is removed, the cheeks applied, the holes laid out, the holes drilled, and fitted bolts applied as described for the link on which the link foot is an extension of the link body. Fig. 4 shows two of the link jigs on the bed of the drill press with the drilling operation just being started.

After the motion work is delivered to the erecting floor, the valve gang assembles it, places the main driving wheels on rollers, and adjusts the height of the wheel centers as shown by *H* in Fig. 5. Throughout this description of setting Walschaert valve gear, the New York Central System H-5h locomotives will be referred to, the valve-gear and valve-setting dimensions of which are given in Table I.

The port marks, showing the points of admission, are scribed on the valve stem on each side of the locomotive. If the distance between the port marks on the right side is not equal to the distance between the port marks on the left side, the valves and ports must be checked to ascertain their correctness as specified in company drawings. When the distances between the port marks on the left and right sides of the locomotive are equal, the striking points of the pistons are obtained and their locations are permanently indicated on the guides by center-punch marks. The main rods, radius bars, and upper end of the combination levers are then connected up. The wheels are then rolled and the extreme travel marks of the crosshead are scribed on the guides by direct observation when the piston stops moving, and if it is necessary to adjust the main rod to give equal clearances on both ends of the cylinders, which is required, new travel marks of the crosshead are scribed on the guides. Note that the extreme travel marks of the crossheads are not obtained in the usual manner by stopping the crosshead at some known point ahead of dead center, marking the rim of the main wheel, rolling the wheels until the crosshead goes to dead center and back to the known point ahead of dead center, again marking the rim of the main wheel at this point, and then halving the distance between the marks on the main wheel. With the method of valve setting herein described, this procedure for locating dead centers is not necessary, and, since it is not used, errors in valve movement due to the angularity of the main rod are eliminated. The location of the exact dead centers, eliminating errors due to angularity of the main rods, are obtained by a method which will be described later in this article.

Table I-Walschaert Valve-Gear and Valve-Setting Dimensions for New York Central H-5h Power

	In.
A—Eccentric-crank length	19¾
B—Link radius	71½
C—Union-link length	24
D—Link-foot travel (total)	23⅛
E—Link-foot travel in front of central position	12⅛
F—Link-foot travel in back of central position	11
G—Eccentric-crank throw	22½
H—Center of axle to top of frame	18¼
I—Valve·travel	7
J—Lap	1
K—Lead	⅛
L—Exhaust clearance	..
Main-rod length	125
M—Valve stem made longer due to expansion (when set cold)	3/64

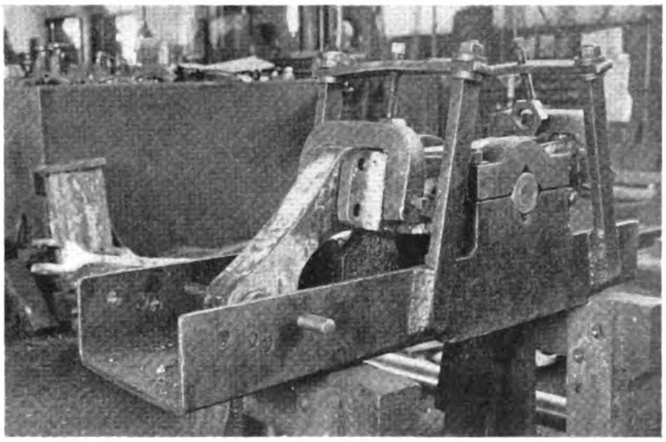


Fig. 3—Link jig with link and link cheeks in position for reaming holes

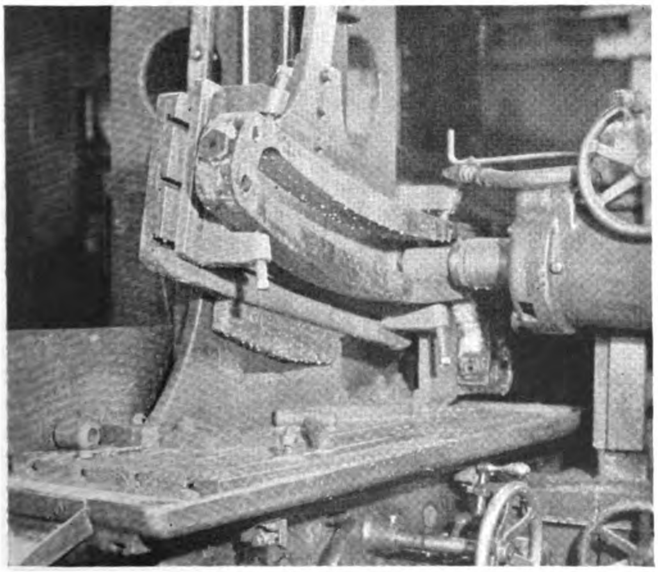


Fig. 2—Link ready for grinding with cone plugs removed from link slot and link foot

Adjusting the Lift Shaft—The lift shaft on the right side of the locomotive is placed in a position such that the link can be swung the full length of its travel with-

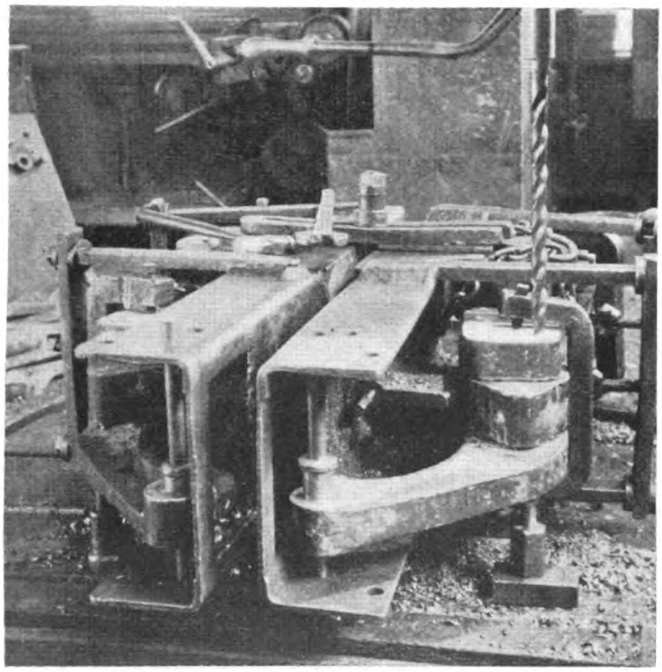


Fig. 4—Link jigs with links in position ready for drilling

out imparting any movement to the radius bar or to the lower end of the combination lever when it is in a vertical position. Without moving the reverse lever, the mechanic goes to the left side of the locomotive and swings the link the full length of its travel. If it is found that the front end of the left radius bar or the lower end of the left combination lever moves, it is evident that the lift-shaft bearings on one side or the other is out of adjustment. If there is movement of the left radius bar or the left combination lever, the mechanic proceeds to make adjustments in the lift-shaft bearings until such movement is eliminated. The lower ends of the combination levers are then coupled to the union links. The location of the valve gear which will impart no movement to radius bars, and therefore the valves, when the link foot is swung through its length of its travel as described in this paragraph, will hereafter be referred to as the mid-position of the valve gear.

Equalizing the Lead—When the valve gear is in mid-position with the eccentric rods connected to the links, and the lower ends of the combination levers coupled to the union links, all movement of the valves is imparted by the combination levers when the wheels are rolled. Each valve will move a distance equal to the sum of the lap plus lead for the head and crank ends of the valve when the wheel is rolled through one revolution. The wheels are rolled until the crossheads are on each travel mark in turn. When a crosshead is on a dead-center position, the valve should be at its extreme travel position and the port should be open an amount equal to the lead, since the valve gear is in mid-position. However, if the valve still moves when the crosshead comes up to any travel mark (which, it will be remembered, was obtained by observation only), the wheels are rolled until the crosshead comes up to and leaves the travel position and when the valve stops moving a line is scribed on the valve stem with the same tram that was used to locate the port marks. The position of a crosshead when the valve stops moving is its exact dead center; the observed crosshead dead-center positions, that is, the travel marks, are checked at this point and the correct travel positions are center punched on the guides. The distances between the port marks on the valve stem and the marks indicating the extreme travel positions of the valves, obtained when the crossheads are on exact dead centers and when the valve gear is in mid-position, are the leads. If the distances between the port marks and the travel marks of the valve, that is, the leads, are not equal for each end of the valve, they are equalized by adjusting the length of the valve stem an amount equal to one half the difference of the distances between the lead and port marks. The valve stem should be left long an amount equal to M given in Table I to allow for expansion. Although M for the class of power used as an example in this description is $\frac{3}{64}$ in., it varies from $\frac{1}{32}$ in. to $\frac{3}{64}$ in. on other classes of power.

Locating the Center of the Link Swing—With the eccentric rods, union links, and main rods all connected, the wheels are rolled until the right crosshead is on its front travel mark. The reverse gear is placed in full-forward position and a line is scribed with the valve tram on the valve stem. The reverse gear is placed in full-reverse position, and a second line is scribed on the valve stem. If the two lines just scribed on the valve stem coincide, the link is obviously in the center of its swing, that is, in its central position. If the two lines do not coincide, the wheels are rolled slowly until the valve tram scribes a line at a point half way between them. The link is then in its central position, and the reverse gear can be moved from full reverse to full forward and back to full reverse without moving the valve. With the link in its central position, and using the center of the eccentric-rod-pin hole in the foot of the link as a center for a long beam tram, a line Z is scribed on the cylinder jacket, as shown in Fig. 5. A line NN is then drawn horizontally on the cylinder jacket as also shown in Fig. 5; this line is located the same height above the rail as the center of the link-foot hole when the link is in its central position.

Determining the Correct Eccentric Throw—In this operation the same beam tram used in locating line Z on the cylinder jacket must be employed. The wheels are rolled slowly and the travel marks of the link foot, shown as X and Y on Fig. 5, are scribed on the cylinder jacket. The mechanic setting the valve obtains the correct travel of the link foot from a print of the Walschaert gear layout, which is shown as dimension D in Fig. 5 and given in Table I for H-5h power. If the travel D of the link foot is greater than that called for in Table I, the eccentric crank is moved toward the center of the axle. If the travel D is less than that called for in Table I, the eccentric crank is moved away from the center of the axle. When the dimension D is made equal to blueprint dimensions as given in Table I by adjusting the eccentric crank on the pin as just described, the correct eccentric throw has been obtained and new lines X and Y are scribed on the cylinder jacket.

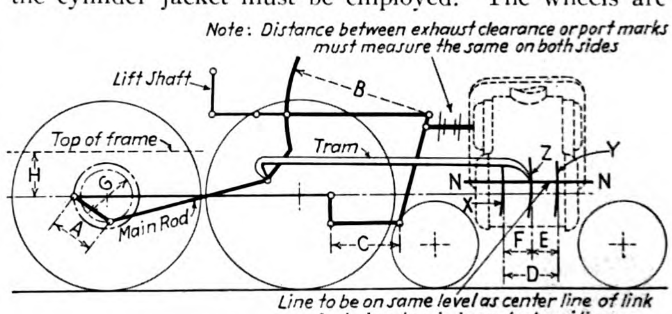


Fig. 5—Walschaert valve gear with link in mid-position—Letters refer to Table I

Determining the Correct Eccentric-Rod Length—The mechanic setting the valve measures the distances E and

F, the link-foot travel in front and in back of the central position of the link swing, respectively, and he checks them with blueprint dimensions as given in Table I for H-5h power. If the dimension *E* is greater than that called for in Table I, it indicates that the eccentric rod is too long by the amount equal to the difference between dimension *E* as obtained on the cylinder jacket and the dimension *E* given in Table I; the eccentric rod is then shortened that amount. The adjustment can also be made by determining the difference between dimension *F* as given in Table I and dimension *F* as obtained from the cylinder jacket. When the eccentric-rod length has been changed, the dimensions *E* and *F* are rechecked, and when they are exactly as given in Table I, the eccentric-rod length is correct.

Adjustment When the Locomotive Is Under Steam—When the locomotive is under steam, the boiler expands, thus necessitating an adjustment of the main reach rod since it was brought to standard blueprint dimensions in the shop. After the engine has been broken in, the lead marks and valve travels are checked and adjustments are made before the locomotive is placed in service.

Setting the Baker Valve Gear

As in the case of setting the Walschaert valve gear, all the motion work when stripped from the locomotive is delivered to the machine shop for restoring parts to blueprint dimensions. After the motion work is delivered to the erecting floor, the valve gang assembles it, obtains the striking points of the pistons, places the main driving wheels on rollers, adjusts the height of the wheel centers as shown by *C* in Fig. 6, and locates the port marks as also shown in Fig. 6. If the distance between the port marks on both sides are not equal, the valve

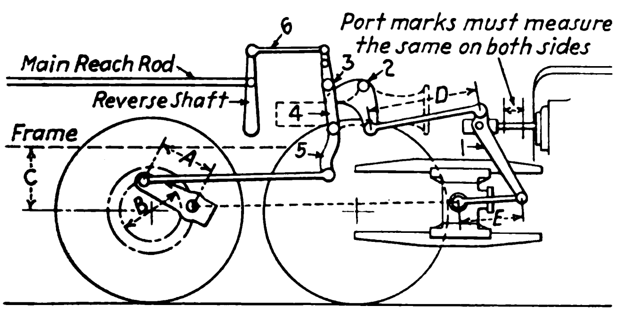


Fig. 6—Assembly of Baker valve gear
(1—Combination lever. 2—Bell crank. 3—Reverse yoke. 4—Radius bar. 5—Gear connecting rod. 6—Gear reach rod. Letters refer to Table II.)

dimensions and port locations are checked for accuracy against the companies drawings. Throughout this description of setting Baker valve gears, the New York Central System L-2 power will be referred to, the valve-gear and valve-setting dimensions of which are given in Table II.

Adjusting the Reverse Yokes—The reverse shaft on the right side of the locomotive is adjusted until it is in a plumb position. The gear reach rod is then adjusted until the distance between the center of the reverse yoke center pin and the center of the bell-crank pin in the frame is equal to *F* shown in Fig. 7 and given in Table II for L-2 power. A tram is used for checking the distance *F*. Leaving the reverse shaft in a plumb position, the mechanic goes to the left side of the locomotive and checks the dimension *F* between the bell-crank pin in the frame and the center reverse-crank pin. If the dimension *F* on both sides are not the same it is evident that the gear reach rod on either one side or the other is out of adjustment. The mechanic then proceeds to make *F* on both sides equal to blueprint dimensions as given in Table II.

Locating the Mid-Position of the Valve Gear in the Erecting Shop—The Baker valve gear cannot be set so there will be no valve movement. However, the mid-position of the gear is obtained by locating the gear to dimension F as shown in Fig. 7. The mid-travel

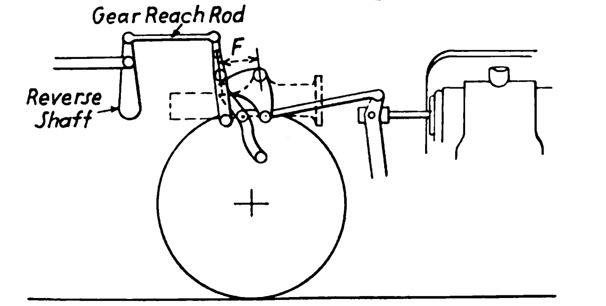


Fig. 7—Position of reverse yoke when gear reach rod is adjusted properly

position of the foot of the gear connecting rod is then obtained as follows:

The main rods, eccentric rods, and union links are connected and the wheels are rolled until the right crosshead is on its front travel mark; as in the case of setting the Walschaert gear all travel marks are first obtained by observation of the crosshead travel and checked for accuracy later. With the crosshead on the right-hand side on its front travel mark, the reverse yoke is placed in its full-forward position, and a line is scribed on the valve stem with the valve tram. The reverse yoke is then placed in its full-reverse position and the valve is again

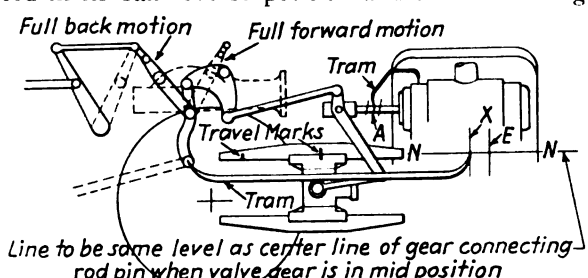


Fig. 8—Baker valve gear set in mid-position

scribed with the valve tram. If the two lines scribed on the valve stem coincide, the gear is in its mid-position. However, if the two lines do not coincide, the wheels are rolled slowly until a line *A*, shown in Fig. 8, is scribed

Table II-Baker Valve-Gear and Valve-Setting Dimensions for New York Central L-2 Power

	In.
A—Eccentric-crank length	20⅛
B—Total eccentric-crank throw	23½
C—Center of driver to top of frame	21
D—Valve-rod length	54⅛
E—Union-link length	26½
F—Center of upper bell-crank pin to center of reverse yoke pin	16⅛
G—Travel of foot of gear connecting rod	23½
H—Travel of foot of gear connecting rod in front of central position	12 7/16
I—Travel of foot of gear connecting rod in back of central position	11 1/16
M—Amount valve stem is made longer due to expansion (when set cold)	..
Valve travel	9
Lap	1 9/16
Lead	5/16
Exhaust clearance	..

mid-way between the two lines. This then will locate the mid-position of the gear. With the gear in this position, a tram extending from the center of the eccentric-rod-pin hole in the foot of the gear connecting rod to the cylinder jacket is used to scribe a line *X* on the cylinder jacket as shown in Fig. 8. The gear on the left side is

then run over in a similar manner, to check the mid-position.

Enginehouse Method for Locating the Mid-Position of the Valve Gear—The eccentric rods are disconnected from the foot of the gear connecting rods, and the cross-head on the right-hand side is placed on its front travel mark. With the union link connected and with the

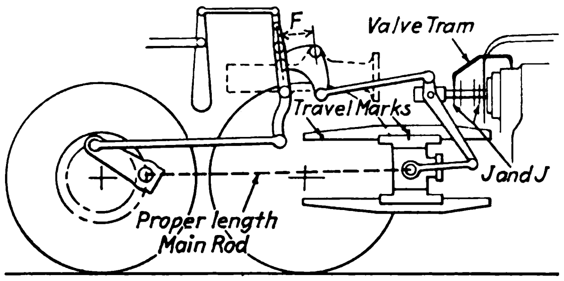


Fig. 9—Baker valve gear in position for adjusting leads

eccentric rod pin temporarily in the hole in foot of the gear connecting rod, the reverse yoke is placed in its full-forward position. One line is then scribed on the valve stem with a valve tram, and another is scribed on the cylinder jacket at *E* with a beam tram extending from the center of the eccentric-rod pin to the cylinder jacket. The reverse yoke is then placed in its full-reverse position and the foot of the gear connecting rod is swung until the beam tram falls on the line *E* previously scribed on the cylinder jacket. A second line is then scribed on the valve stem. The foot of the gear connecting rod is then moved until the valve tram scribes a line mid-way between the two lines; this locates the mid-position of the gear. With the gear in this position the beam tram is used to scribe the line *X* on the cylinder jacket as shown in Fig. 8.

Equalizing the Lead—With the valve gear in mid-position set to dimension *F* as shown in Fig. 9, with the eccentric rod connected or disconnected and with the main rod connected or disconnected, the right crosshead with the union link connected is moved up to and away from the right-front travel mark. A line is scribed on the valve stem when the valve stops moving; the position of the crosshead when the valve stops moving is the exact front dead center and the travel mark previously obtained by observation is checked at this point. The crosshead is then moved up to and away from the back travel mark, and a line is scribed on the valve stem when the valve stops moving; the position of the crosshead when the valve stops moving is the exact back dead center. The lines scribed on the valve stem are the lead marks as shown as *JJ* in Fig. 9. If the distances between the lead marks and the port marks are not the same, the valve stem must be lengthened or shortened accordingly to equalize the leads. The valve stem is left long an amount shown by *M* as shown in Table II to allow for expansion (zero for L-2 power). During this operation the exact dead-center marks are permanently located on the guides by center-punch marks.

Determining the Correct Eccentric Throw—A horizontal line is drawn on the cylinder jacket at the same height above the rail as the center of the hole in the foot of the gear connecting rod. With the reverse yokes set to dimension *F* shown in Fig. 10 and given in Table II for L-2 power, so that the gear is in its mid-position, the wheels are rolled and the travel marks of the foot of the gear connecting rod are scribed with the beam tram on the cylinder jacket at *Y* and *Z* as shown in Fig. 10. If the distance *G* between *Y* and *Z* is equal to *G* as given in Table II, then the eccentric-crank throw is correct. However, if *G* is greater than that given in Table II, the eccentric crank should be moved towards the center of the wheel, and if less the crank should be moved away from the center of the wheel, until the travel *G* shown in Fig. 10 is equal to dimension *G* given in Table II. When this is accomplished, the correct eccentric-crank throw has been obtained, and new lines *Y* and *Z*, indicating the correct distance *G* are drawn on the cylinder jacket.

Determining the Correct Eccentric-Rod Length—After scribing the correct lines *Y* and *Z*, the mechanic measures the distance *H* shown in Fig. 10, and refers to Table II for its correct length. If *H* as measured on the jacket is greater than that given in Table II, the eccentric rod is too long by that amount and it is shortened accordingly. On the other hand, if *H* as measured on the jacket is shorter than that called for in Table II, the eccentric rod is lengthened by an amount equal to their difference. The distance *I* as obtained on the jacket can also be checked against dimension *I* in Table II for obtaining the correct eccentric-rod length.

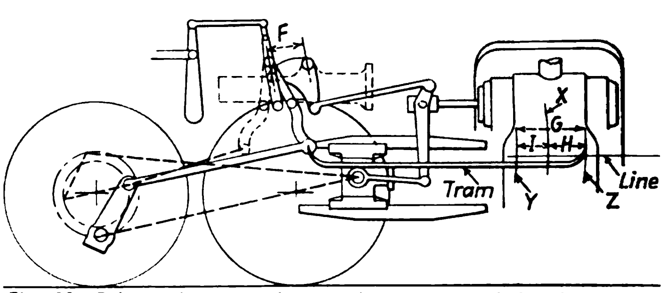


Fig. 10—Baker valve gear showing dimensions used for determining correct eccentric-rod length

After the eccentric-rod length has been changed, the valves are again run over and the dimensions *I* and *H* as obtained on the jacket are checked against the correct values as given in Table II.

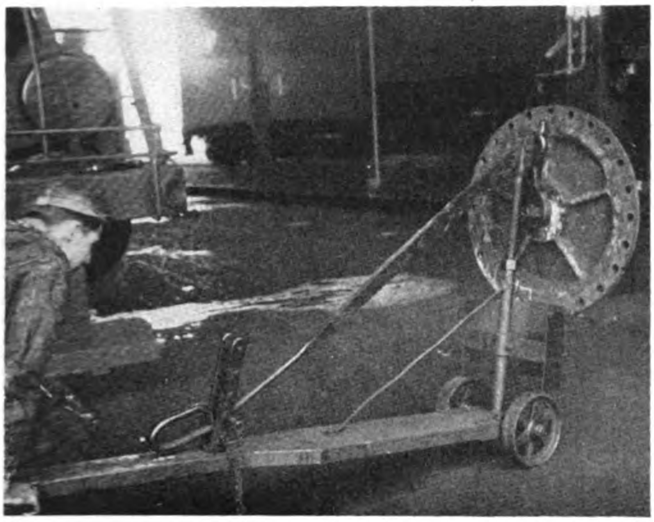
Adjustments Under Steam—When the locomotive is under steam the boiler expands, thus necessitating adjustment of the main reach rod since the reach rod was brought to standard blueprint dimensions in the shop. After the engine has been broken in, the lead marks and valve travels are checked and adjusted if necessary before the locomotive is placed in service.

Two-Wheel Truck for Applying Cylinder Heads

An ingenious two-wheel truck arrangement for applying locomotive cylinder heads at the Illinois Central enginehouse, Markham, Ill., is shown in the illustration. It consists of two 12-in. plain truck wheels mounted at one end of a wooden base plank which carries a vertical steel tube and bar construction to support the weight of the cylinder head and a diagonal bar and handle which may be used to give necessary minor adjustments in height of the carrying hook. The use of this device enables relatively heavy cylinder heads to be easily moved about the shop and applied over the cylinder studs.

The base of this truck is made of a 2-in. by 10-in. plank, 6 ft. long, the outer end of which is narrowed to about 6 in. and equipped with a cross-handle for ease of handling. The main vertical supporting member is 4 ft. long and consists of a section of 2-in. flue in the upper end of which is inserted a 1½-in. threaded steel rod the height of which is adjustable by means of a nut. The upper end of this adjusting screw is forged in the form of a clevis with pin connection to the diagonal steel bar,

made of 1-in. by 2½-in. stock and forged to form a hook at the upper end for engagement with the special forged link which is bolted to the cylinder head center lifting stud. The lower end of the diagonal bar is drawn out to form a handle which is held in position against the



Heavy cylinder heads can be moved easily with this truck

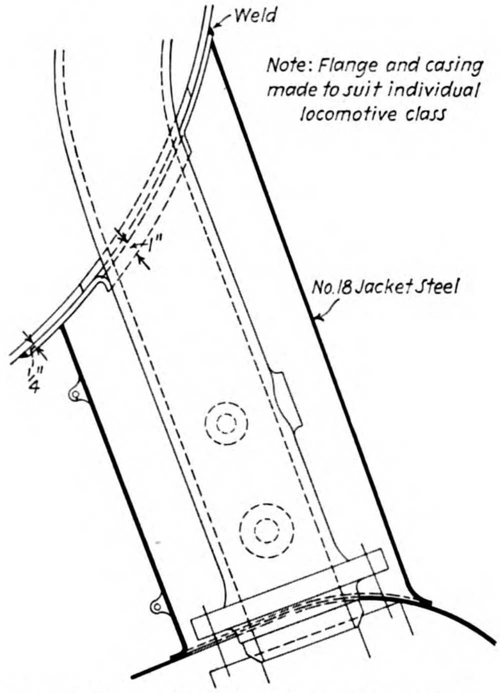
base plank by means of a bracket and adjustable bolt connection, as shown.

A semi-circular steel plate 12 in. wide by 16 in. in diameter, made of $\frac{3}{16}$-in. stock, is attached near the vertical tube, as shown, and serves to hold the cylinder head vertical when applying it over the cylinder studs. In operation, this device may be readily used to lift the cylinder head from the floor and move it into position in front of the cylinder where any necessary adjustment for height may be made and the cylinder head easily applied over the studs.

Two Locomotive Design Details

Two improved details of locomotive design which have given unusually good results on the Indiana Harbor Belt are shown in the illustration, comprising a steam-pipe casing and a cover plate for grate connection rods.

The steam-pipe casing forms an air-tight joint, where each steam pipe passes through the smokebox sheet, by means of a simple design which can be easily applied at small expense. The casing consists simply of a pressed-steel flange fitted accurately around the steam pipe and welded to the smokebox, with the usual cylindrical jacket extending down to the steam chest. The flange, formed of ¼-in. steel, is, of course, made in two pieces for application around the steam pipe, the joint being electrically welded. Also, the outer edge

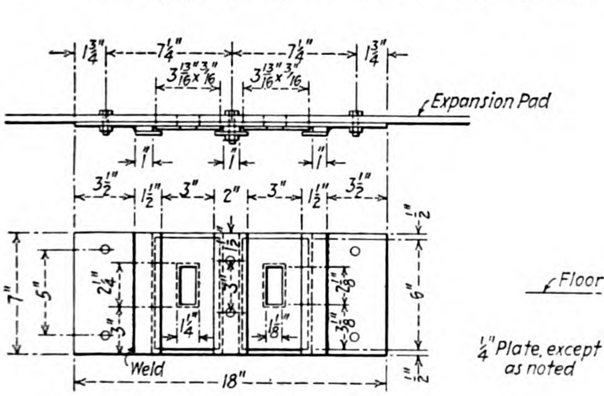


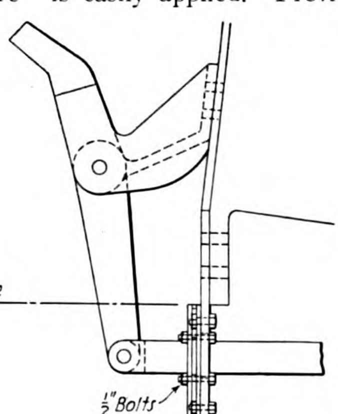
Simple and effective design for a locomotive steam-pipe casing

of the flange is electrically welded to the smokebox. The jacket made of No. 18 gage steel, is cut to the proper shape and applied in one piece around the steam pipe, after the latter is insulated with a thick coat of plastic asbestos. The two edges of the jacket joint are held together by bolts through two lugs.

Since the flange is welded in place, it must be cut away in order to remove the steam pipe, and generally cannot be used again. Since steam pipes have to be taken out at only infrequent intervals, however, and in view of the relatively small difficulty and cost of applying new flanges, this feature does not constitute a serious objection to the use of the steam pipe casing design described.

The type of cover plate for grate-connecting rods now used as standard on Indiana Harbor Belt locomotives, is easily applied. Previous to the development of this design, small sheet metal cinder boxes were applied to the outside of the rear waste sheet just below the cab floor, designed to catch live cinders which might otherwise work out of the firebox when the grate shaker





Sliding cover plate design for locomotive grate connection rods

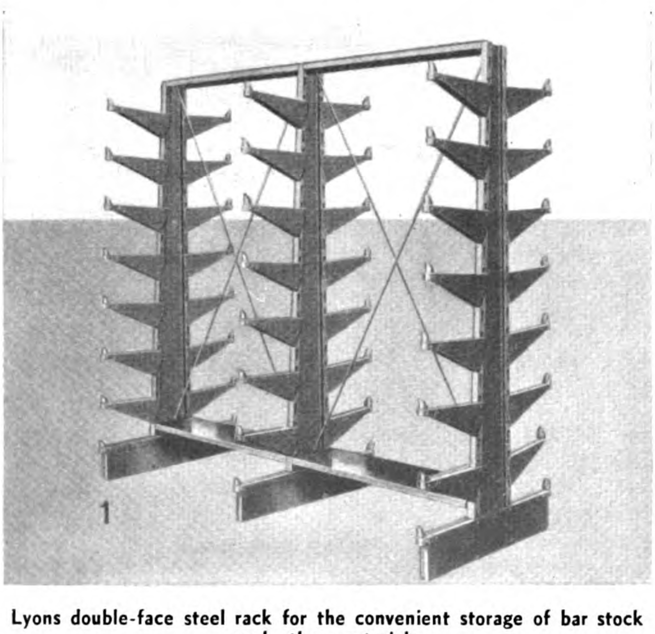
levers are operated, and thus cause a fire hazard. The difficulty with these cinder boxes is that they may become filled with wet or damp cinders in the winter time and freeze, preventing operation of the grate shaker levers.

In the design illustrated, a small rectangular plate, made of 1/4-in. steel, 6 in. long by 3 in. wide, is provided with a 2 1/2-in. by 1 1/8-in. hole just large enough to fit around the grate rod. This plate is allowed to move vertically as much as may be required during operation of the grate shaker lever, by sliding in suitable guides welded to a back plate which is bolted to the rear waste sheet, or expansion pad, as it is sometimes called. These cover plates effectively close the openings where the grate rods pass through the waste sheet and prevent the emission of live cinders.

Rack for Storing Steel Bars

The steel bar rack, illustrated, is made by Lyon Metal Products, Incorporated, Aurora, Ill., and adaptable for a variety of purposes in railroad shops as well as manufacturing plants and storehouses. The rack is available in either the single- or double-face type, in two standard heights, 79 in. and 97 in., and an upright spacing of 36 in. or 48 in. The cantilever arms, on which the pipes and rods may be stored, are 12 in. long and adjustable on 3-in. centers. If the storage of long, bulky items is desired, shelves can be easily placed on these arms and material or merchandise of unusual length that must be conveniently stored flat will be kept in good condition.

The bar rack is of sturdy construction, finished in



Lyons double-face steel rack for the convenient storage of bar stock and other materials

green baked enamel. It is made of heavy gage steel in channel and L-shapes to give necessary rigidity and strength. The weight-carrying capacity is somewhat indefinite and depends more or less on whether the weights are concentrated in one spot or spread over the entire rack. Each upright rests on a base piece or floor bar which is 31 1/2 in. long on a double-face rack. A compression shelf ties the uprights together at the top and there is also a compression shelf at the bottom. The rack is stiffened against side sway by means of brace rods, as shown in the illustration. The cantilever arms are secured to the uprights by locking them in suitable slots, and they are therefore readily adjustable for varied spacing to meet the requirements of different kinds of materials being stored.

How to Recondition Water-Soaked Tools

The more or less frequent recurrence of flood conditions in various parts of the United States has led the Black & Decker Manufacturing Company, Towson, Md., to issue instructions for the reconditioning of water-soaked electric tools, which are of general interest. In most cases, submersion practically ruins the insulation in the tools as well as rendering the fibre parts unfit for use, diluting and contaminating the grease and covering all parts with silt and mud. Obviously, these tools should not be operated until after having been thoroughly reconditioned, preferably by the manufacturer.

In cases where the owner desires to service the tools at local shop points, the following procedure is suggested: Completely disassemble each tool so as to get at all parts. The armature and field should be baked for 24 hr. at a temperature of 275 deg. F., then being checked for short and grounds, a coat of insulating compound applied and the parts again baked for 12 hr. at 275 deg. F. All fibre switch and brush riggings should be replaced. Most switches will have to be replaced and all taped wire connections should be cleaned and retaped. Clean all ventilating holes in the case of the tool. Wash all grease from gears, housings and bearings, using a suitable fluid, and repack with new lubricant, comprising a good grade of medium cup grease. Clean rust and dirt from all parts.

These instructions apply to electric grinders, both the portable and bench type, sanders, polishers, drills, screw drivers, hammers, saws, valve refacers and most types of motor-driven electric tools.

Reconditioning Tools at Paducah Shops

Electrical equipment submerged at the Paducah, Ky., shops of the Illinois Central, as referred to in an editorial elsewhere in this issue, comprised approximately 525 electric motors which were subjected to flood water and required baking out. One of three different processes was used, dependent upon conditions. The first was removing the motor from the machine, placing it in a baking furnace where the temperature was maintained at 220 to 240 deg. F. and the time required ranging from 18 to 48 hr. for each motor, depending upon the type of winding. In the drying of other motors, a paraffin bath was used, while on still others an electric current was passed through the motor windings, the temperature being governed by voltage control. Each of these three processes produced the desired results under the particular conditions involved.

As stated in the editorial, approximately 550 shop machines and furnaces were under water and required attention, the machines being completely disassembled in most instances, all parts thoroughly cleaned, reassembled and provided with new lubricants. In the cleaning of heavy machine parts, the dipping process was extensively employed, using a solution of caustic cleaning compound, No. 5-B, furnished by the International Chemical Company, Philadelphia. Most of the small tools, not heavily coated with grease, were dipped in a bath of Oakite No. 32, and serving principally as a rust remover. The tools were then rinsed in plain water,

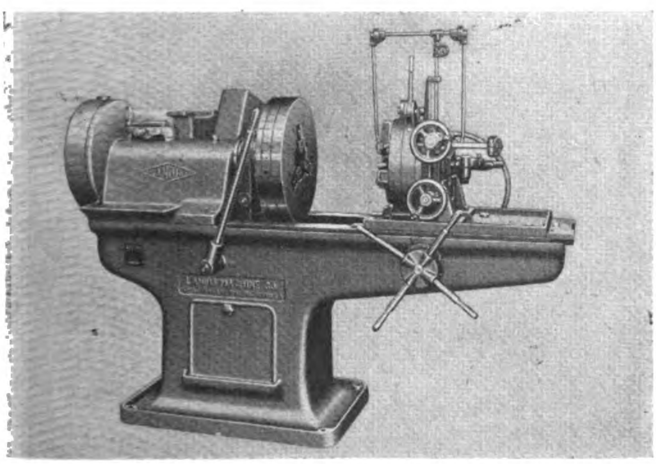
dipped in a bath of boiling Oakite No. 24, and finally immersed in an oil bath. In the case of small tools, heavily coated with grease, the first process was boiling in a bath of Oakite No. 24, then returning to the regular procedure already described. The use of this method of cleaning shop machinery and tools proved very effective and permitted reconditioning a large number of tools in record time.

Pipe Threading And Cutting Machine

The Landis Machine Company, Inc., of Waynesboro, Pa., has redesigned its 2-in. pipe threading and cutting machine, which is furnished with either motor or belt drive, and equipped it with an eight-speed built-in gear box with single-pulley drive. For a motor-driven machine the motor is mounted on top of the headstock and connected to the main drive shaft by a silent chain drive. The chuck speeds available are 30, 40, 52, 67, 72, 90, 125, and 163 r.p.m. The speed of the main drive shaft is 425 r.p.m.

The ways of the redesigned machine are covered by steel guards which are attached to the cross rail and are telescoped under the headstock in order to protect the ways at all times. Although the redesigned unit now weighs slightly more than the machine which it replaces, because the bed has been made heavier and stronger by increasing the thickness and number of the webs and ties, it requires practically the same floor space as the old machine.

A gear box very similar to the one used on the old 2-in. threading machine is employed on this machine.



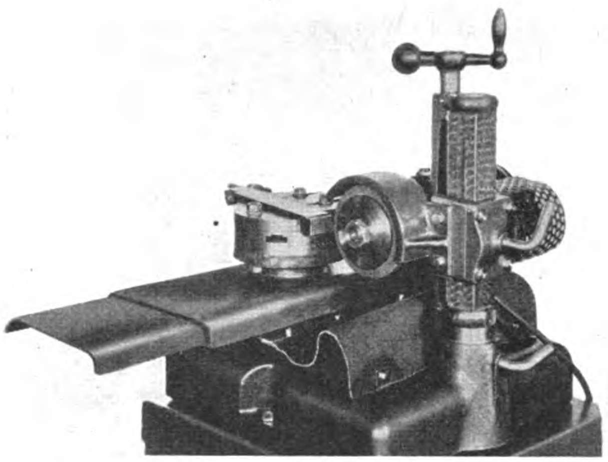
The redesigned Landis 2-in. pipe-threading and cutting machine

The speed-change gears are all made of chrome nickel steel, are hardened and burnished, and run in oil. All gears are mounted on antifriction bearings on heat-treated shafts.

The headstock is set directly on the bed instead of on raising strips as on the old machine. No changes have been made in the die head, cross rail, cutting off attachment, and chucks. This machine has a capacity for threading pipe from ½ in. to 2 in., inclusive; it has a carriage travel of 14 in., and requires floor space 3 ft. 7 in. wide by 6 ft. 8½ in. long. The belt-driven machine weighs 2,800 lb. net. The motor-driven machine weighs 3,000 lb. net and is powered with a 3-hp. a.c. or d.c. motor which runs at an approximate speed of 1,200 r.p.m.

Grinder for Threading Dies and Chasers

In the illustration is shown a grinder for threading dies and chasers of all kinds. It is equipped with a fixture and wheel for each type of chaser to be ground, to-



The Tom Thumb Oster grinder for dies and chasers

gether with a micrometer adjustments for grinding cutting edges and leads. A thin wheel also is furnished for grinding out broken teeth. This unit is called the "Tom Thumb" chaser grinder and is manufactured by the Oster Manufacturing Company, Cleveland, Ohio. Standard equipment with the grinder consists of one set of fixtures and wheels for grinding any one type of chaser, a ¼-hp. Universal motor, and a dressing stick for grinding wheels. The base of the unit is 13 in. square and it is 17½ in. high. It weighs approximately 125 lb. A welded steel stand with a built-in shelf for extra fixtures can be furnished as an extra for mounting the grinder.

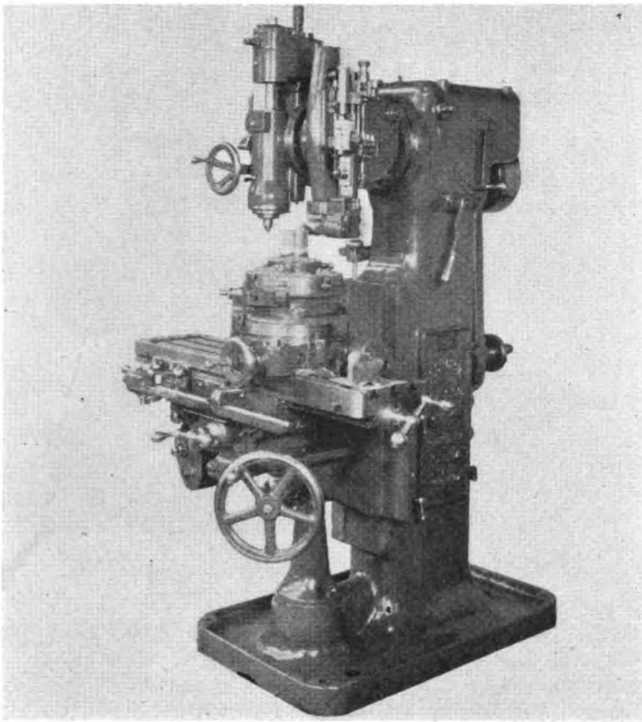
Universal Vertical Miller-Shaper

Improvements have recently been made on the Colby Universal vertical milling and shaping machine shown in the illustration. The machine has been provided with a high-speed spindle mounted in antifriction bearings, and has ten right-hand speeds, the maximum of which is approximately 2,100 r.p.m. The spindle is equipped with a sleeve to hold ⅛-in. to ⅝-in. split collets, thus eliminating the need for a high-speed attachment. This spindle can be furnished either with or without power down feed with four changes applicable to any spindle speed. The feed has an automatic stop and a micrometer screw for gaging depth.

A radius tool attachment is furnished with the machine which fits the shaper ram in place of the clapper block, and will shape punches from the rough without undercutting. A punch located on the compound circular table can be machined on all sides, developing, from any center within a 5-in. circle, true radii, tangent and angular cuts. These table settings can be duplicated when machining the die opening with a regular tool holder. The accuracy obtained results, on many dies and punches, in a large saving of transfer and set-up time, and in filing and fitting.

The milling and shaping heads adjust at any angle

right to left, or left to right from vertical to horizontal and 45 deg. front and back from center for drilling, millings, boring, shaping and slotting operations with constant power feed for milling, and intermittent feed for



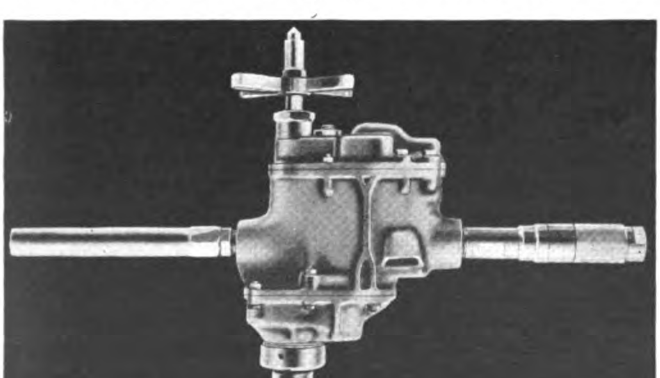
A Universal miller-shaper adaptable for work previously limited to horizontal-spindle machines

shaping. These adjustments apply to all longitudinal, transverse, and circular table movements.

The table can be arranged to receive a 10-in. Universal dividing head. Spiral gears, milling cutters, and a variety of other work on centers formerly limited to horizontal spindle type machines can be done on this Universal vertical machine. The machine and attachments are built by the Cochrane-Bly Co., Rochester, N. Y.

Rotor Non-Reversible Air Drill

A non-reversible rotor-type air drill with a multi-port governor which controls the free speed, thus preventing burning of drills and reamers and at the same time reducing the air consumption, has been announced by the Rotor Air Tool Company, Cleveland, Ohio. The



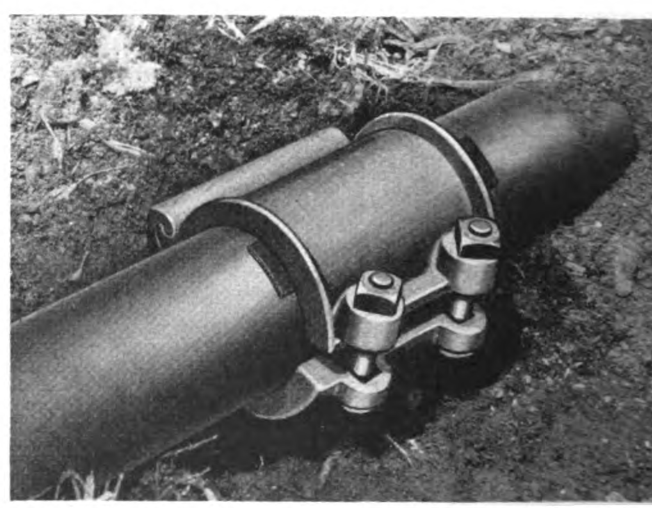
The Rotor light-weight air drill

drill is made in two models. The E-73 model operates at speeds of 450 and 300 r.p.m. for drilling capacities of 29/32 in. and 1¼ in., and reaming capacities of 13/16 in. and 1 in., respectively. The other model, designated as the E-72 drill, operates at 450 r.p.m. and has 29/32 in. and 13/16 in. drilling and reaming capacities, respectively. Both models weigh 22 lb. and have an overall length of 13¼ in., including the grip handles. The distance from the side to the center of the spindle is 1⅞ in. on both models. They are furnished with a heavy-duty screw feed of 4 in. travel. The cylinder housing and gear case are made of heat-treated aluminum alloy with rib reinforcements.

Emergency Clamp For Pipe

Emergency and, in some cases, permanent repairs to leaky pipe lines conveying steam, water, gas, oil, ammonia or brine are readily made by means of various types of special pipe clamps manufactured by the M. B. Skinner Company, South Bend, Ind. Only one of these clamps is shown in the illustration, consisting of a malleable iron cylinder, halved, hinged along one side and fitted with bolts on the other, a gasket of suitable material being inserted over the crack in the pipe. This type of clamp is very easily applied when a leak develops. Owing to the long open hinge, the two halves of the clamp may be slid together along the pipe when space is limited, and a small wrench can be used to tighten the nuts on the bolts, which are cadmium plated.

Due to the small area of average pin hole or corrosion leaks, the Skinner pipe clamp is said to stop the leak regardless of pressure. The clamp is also a safety feature and may be carried in stock in all sizes as an insurance against leakage. The clamp comes complete with a

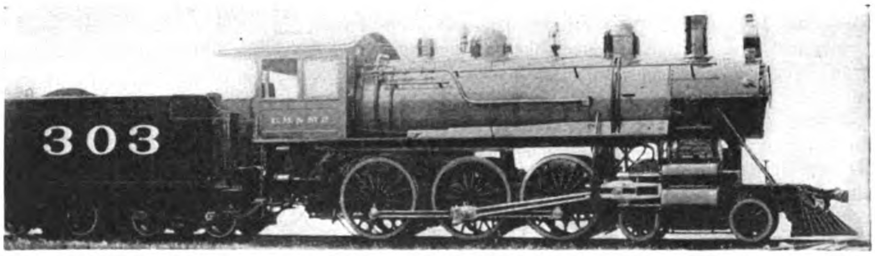


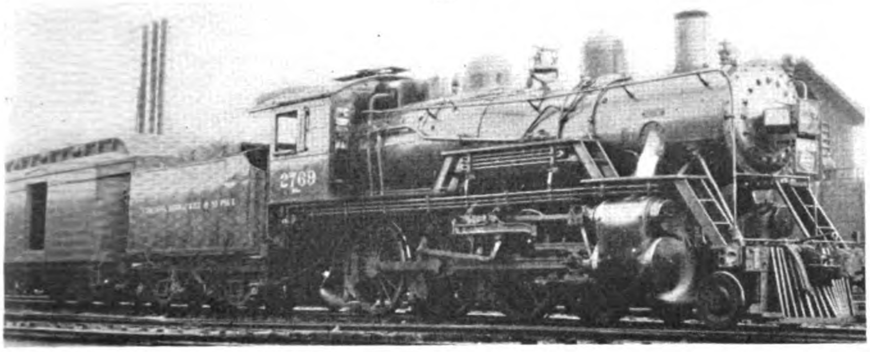
Skinner clamp for permanently stopping pipe leaks

gasket, but if other gasket material is required, it should be cut to the same dimensions, for a gasket cut too large diffuses the pressure. It is by concentration of pressure on the leak that this clamp makes a positive, permanent repair.

This general type of Skinner pipe clamp is available in other detail designs such as an extended pipe-line clamp, a pipe-joint clamp which may be readily applied next to a fitting, a collar-leak clamp, a bell-joint clamp a split-coupling clamp, a high-pressure-weld clamp and various types of band and saddle clamps.

The Metamorphosis of a Steam Locomotive on the Milwaukee





Above: One of 25 Baldwin-built Vauclain compounds delivered to the Milwaukee in 1900—Left: The locomotive as equipped with a larger superheated-steam boiler, simple cylinders and outside valve gear in 1926—Below: A locomotive of the same class equipped with a specially decorated streamline housing (but otherwise unchanged) and now used to haul a section of the Hiawatha over a secondary line in Wisconsin

NEWS

Santa Fe's Chief To Be Streamline

PLANS have been completed by the Atchison, Topeka & Santa Fe for the conversion of its Chief, operating between Chicago and Los Angeles, Calif., to a lightweight, streamline train, by the introduction of new Pullman cars, and new coaches, club cars and dining cars. Each of the six units of the ten-car train comprising the new Chief will consist of a club-baggage car, a club-lounge car and a dining car, which are now being built by the Edward G. Budd Manufacturing Company for the Santa Fe, and an observation, four-drawing room, double bedroom sleeping car; a 14-section sleeping car; an 18-roomette sleeping car; 2 two-drawing room, two-compartment, four double-bedroom sleeping cars; and 2 eight-section, two-compartment, two-double bedroom sleeping cars.

In addition, four additional dining cars and three additional sleeping cars will be included in the pool, making the total number of cars 67. The 45 sleeping cars will be constructed by the Pullman-Standard Car Manufacturing Company for the Pullman Company, while the remaining 22 cars are a portion of the 52 cars ordered by the Santa Fe from the Edward G. Budd Manufacturing Company. These 45 Pullman cars contain new features not found at present in standard sleeping cars. The drawing rooms and compartments are designed for added room and comfort, with a different layout. The roomette car is a new type, containing 18 separate, individu-

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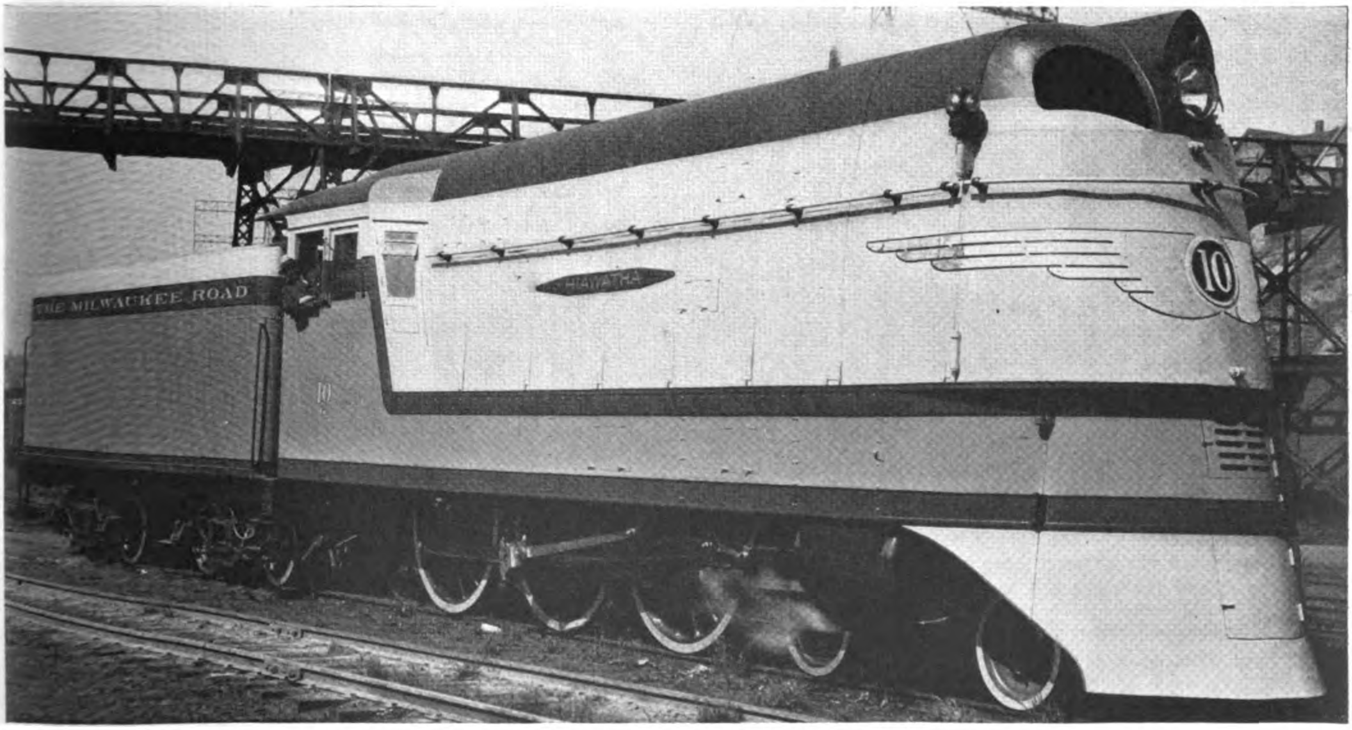

ally enclosed roomettes designed for one passenger, and containing a folding bed-type berth, washstand, toilet and wardrobe.

Thirty of the cars ordered from Budd, all coaches, will be placed in service on the Scout, the Santa Fe's all-coach tourist-sleeping car operating between Chicago and San Francisco, Calif., and Los Angeles.

Southern Pacific Locomotives—A Correction

The Franklin Railway Supply Company, New York, furnished the boosters on the Southern Pacific 4-8-4 type locomotives described in the March issue of the *Railway Mechanical Engineer*. The company is incorrectly given in the list of specialties on page 105.

Diesel Locomotive Repair Costs—A Correction

In the publication of the article entitled "Diesel-Electric Locomotive Projected Repair Costs" which appeared on page 111 of the March issue reference was omitted of the fact that the article was an abstract of a report prepared for the Northampton & Bath by John P. Kivlen, engineer maintenance of way and equipment.

Missouri Pacific Plans New Enginehouse

The Missouri Pacific is contemplating the construction of an eight-stall frame enginehouse at Atchison, Kan., to replace an existing structure, at a total estimated cost of about $114,000. The work will involve considerable revision of the terminal track layout to accommodate the new house and to secure greater economy in the operation of the terminal.

President Appoints Locomotive Bureau Official

President Roosevelt has appointed Allyn C. Breed assistant chief inspector of the Bureau of Locomotive Inspection of the Interstate Commerce Commission and has sent his name to the Senate for confirmation. Mr. Breed was the senior inspector in point of service in the bureau, having come with the commission on August 10, 1911. He takes the place of John A. Shirley, who was retired.

New "Century" and "Broadway" Planned

New streamline equipment and expedited schedules for the New York Central's "Twentieth Century Limited" and the Pennsylvania's "Broadway Limited" were forecast in a joint statement issued by those two roads on March 9. These two trains, on which a charge of $7.50 in addition to the New York-Chicago fare is now assessed, make the run between those cities in 16½ hrs.; and the statement says that "a quickening of passenger schedules" in this service is contemplated.

Staff engineers of the two roads and industrial engineers are collaborating in the design and construction of entirely new equipment for the trains. The program also contemplates a general improvement in and the extension of the new type of equipment to certain other principal services between eastern and western terminals of the two roads.

"The new equipment" the statement con-

(*Continued on next left-hand page*)

New Equipment Orders and Inquiries Announced Since the Closing of the March issue

Locomotive Orders

Road	No. of locos.	Type of loco.	Builder
A. T. & S. F.	1 [1]	3,600-hp. Diesel-elec.	Electro-Motive Corp.
C. W. Pullman & Sou.	2	0-6-0	Baldwin Locomotive Works
Lehigh Valley	10	Loco. tenders [2]	American Locomotive Co.
Mo. Pac.	4	600-hp. Diesel-elec.	Electro Motive Corp.
	2	900-hp. Diesel-elec.	
Nor. Pac.	11 [3]	4-8-4	Baldwin Locomotive Works
	6 [3]	4-6-6-4	American Locomotive Co.
St. L.-S. W.	5	4-8-4	Company shops
Youngstown & Northern	2	900-hp. Diesel-elec.	American Locomotive Co.
	2	900-hp. Diesel-elec.	Electro-Motive Corp.

Locomotive Inquiries

Road	No. of locos.	Type of loco.	Builder
Grt. Western	1	Lt. wt. 2-8-0	....
	1	Heavy wt. 2-8-0	....
M. St. P. & S. Ste. Marie	4	4-8-4	....
Nat'l Rys. of Mexico	10	4-6-2	....
	8	2-6-6-2	....
Seaboard Air Line	10	Loco. tenders	....

Freight-Car Orders

Road	No. of cars	Type of car	Builder
D. M. & N.	500	Ore	General American Trans. Co.
D. T. & I.	400	Box	Greenville Steel Car Co.
	350	Auto.	Bethlehem Steel Co.
Central of Georgia	500	50-ton box	Pullman-Standard Car Mfg. Co.
	100	50-ton auto.-furn.	American Car & Foundry Co.
G. T. W.	100	70-ton gondola	Magor Car Corp.
	100	Refrig.	Pullman-Standard Car Mfg. Co.
	200	Auto.	Pullman-Standard Car Mfg. Co.
Michigan Limestone & Chemical Co.	15	30-cu. yd. air dump	Austin-Western Road Machy. Co.
	15	30-cu. yd. air dump	Differential Steel Car Co.
M., St. P. & S. Ste. M.	100	Ballast	American Car & Fdry. Co.
M-K-T	50	70-ton Hart selective ballast	American Car & Foundry Co.
Nor. Pac.	750	50-ton gondola	Pressed Steel Car Co.
	250	70-ton gondola	American Car & Foundry Co.
	500	50-ton flat	Bethlehem Steel Co.
	500	Box	Pacific Car & Foundry Co.
N. & W.	1,000 [4]	Hopper coal	Virginia Bridge Co.
	1,000 [4]	Hopper coal	Bethlehem Steel Co.

Freight-Car Inquiries

Road	No. of cars	Type of car	Builder
A. C. L.	100-400	50-ton box	....
	100	50-ton auto. with loaders	....
	100	50-ton auto.	....
	100	70-ton phosphate	....
C. N. O. & T. P.	2,500	40-ton box	....
	500	40-ton auto.	....
	1,100	50-ton hopper	....
	1,250	50-ton gondola (high side)	....
	250	50-ton gondola (low side)	....
L. & N. E.	100	70-ton gondola	....
	100	70-ton covered hopper cement	....
M. St. P. & S. Ste. Marie	250-350	50-ft. box	....
	100	40-ft. box	....
	100	Hopper	....
	100	General service	....
	100	Ballast	....
Pennsylvania	1,000	Box	....
	1,500	Gondola	....
	300	Covered hopper cement	....

Passenger-Car Orders

Road	No. of cars	Type of car	Builder
A. T. & S. F.	30 [5]	De luxe coaches	Edward G. Budd Mfg. Co.
	10 [5]	Diners	Edward G. Budd Mfg. Co.
	6 [5]	Club-lounge	Edward G. Budd Mfg. Co.
	6 [5]	Club-baggage	Edward G. Budd Mfg. Co.
Can. Pac.	21	First-class coaches	See footnote [6]
	1	Coach	See footnote [6]
	1	Cafe-parlor	See footnote [6]
	2	Bagg.-exp.	National Steel Car Corp.
	5	Mail-exp.	National Steel Car Corp.
Central of Georgia	5	Coaches	Bethlehem Steel Co.
	3	Express	Bethlehem Steel Co.
Erie	80	Milk	Greenville Steel Car Co.
Grt. Nor.	12	Coaches	Pullman-Standard Car Mfg. Co.
N. Y. N. H. & H.	50 [7]	Coaches	Pullman-Standard Car Mfg. Co.
	5 [7]	Cafeteria	Pullman-Standard Car Mfg. Co.
N. & W.	9	Postal	Bethlehem Steel Co.
St. L.-S. W.	10	Air-conditioned coaches	Pullman-Standard Car Mfg. Co.

Passenger-Car Inquiries

Road	No. of cars	Type of car	Builder
A. C. L.	15	Coaches	....
	15	Express	....

[1] The locomotive will be used to haul the nine light-weight streamline passenger cars now being constructed to replace the present equipment of the Super Chief this spring between Chicago and Los Angeles, Calif.

[2] The tenders will have a capacity of 30 tons of coal and 20,000 gal. of water.

[3] Eight of the 4-8-4 type are for the Northern Pacific. The remaining three 4-8-4's and the six 4-6-6-4 type are for the Spokane, Portland & Seattle. The 17 locomotives are in addition to the order for nine 4-6-6-4's reported in the February issue.

[4] In addition to previous orders for 1,000 cars each placed with these companies.

[5] To be of stainless-steel, streamline construction.

[6] Frames to be built by National Steel Car Corporation and cars finished at Angus shops of the Canadian Pacific.

[7] Permission to purchase this equipment granted by the Court. The coaches will be duplicates of the 50 purchased in 1934 and the 50 additional in 1936. The five cafeteria cars will be duplicates in structure and appearance of the passenger cars, but with different interiors. They will have a self-service counter and bar and will be provided with chairs and tables for serving food and drink.

tinues, "will mark a distinct departure from that now in service." It will include lounge, sleeping and observation cars, to be built by the Pullman Company in accordance with designs now being worked out in cooperation with the two roads.

Both the Pennsylvania and New York Central, the statement further reveals, have been experimenting with modernistic equipment and also have been studying new types of equipment, which have been in operation in other territories, with a view to adopting designs suitable to the service requirements and operating conditions on their respective systems.

Diesel "Firemen" Get Jobs Insured

An agreement governing the employment of firemen (helpers) on Diesel-electric, other internal-combustion and steam-electric locomotives was reached in a joint conference committee of managers, representing most of the principal railways of the country, and officers of the Brotherhood of Locomotive Firemen and Enginemen, at Chicago, on February 28. The request for extra men was made by the brotherhood on October 31, 1936, and negotiations were begun on February 17. It is estimated that 230 new jobs will be created for firemen, with a resulting increase of $445,000 in payrolls. The agreement became effective March 15.

Under the agreement, firemen (helpers) shall be employed on Diesel-electric, oil-electric, gas-electric, other internal-combustion, or steam-electric locomotives, on streamline or main-line through passenger trains which make few or no stops, and on Diesel-electric, oil-electric, gas-electric, other internal-combustion, steam-electric, or electric locomotives, of more than 90,000 lb. weight on drivers, regardless of service. "Locomotives" not included in the agreement are: (a) Electric car service, operated in single or multiple units; (b) gasoline, Diesel-electric, gas-electric, oil-electric, or other rail motor cars, which are self-propelled units (sometimes handling additional cars) but distinguished from "locomotives" in having facilities for revenue lading or passengers in the motor car, except that new rail motor cars henceforth installed which weigh more than 90,000 lb. on drivers shall be considered "locomotives," requiring a helper. If the power plants of existing rail motor cars be made more powerful by alteration, renewal, replacement, or any other method, to the extent that more trailing units can be pulled than could have been pulled with the power plants which were in the rail motor cars on March 15, 1937, such motor cars, if then weighing more than 90,000 lb. on drivers, shall be considered locomotives requiring a helper. (c) Self-propelled machines used in maintenance of way, maintenance of equipment, stores department and construction work, such as locomotive cranes, ditchers, clam-shells, pile-drivers, scarifiers, wrecking derricks, weed burners, and other self-propelled equipment or machines. This will not prejudice local handling on individual railroads where disputes arise as to whether or not the character of work performed by these devices constitutes road or yard engine service.

Rates of pay applicable to coal-burning steam locomotives apply on streamline or main-line through passenger trains except where only oil-burning locomotives are used. Rates of pay for helpers on electric locomotives (from individual or territorial schedules) apply to firemen (helpers) on other types of motive power of more than 90,000 lb. weight on drivers.

Existing agreements which are considered by the employees to be more favorable shall remain unchanged.

This agreement shall continue in effect for a period of one year and thereafter, subject to change under the provisions of the Railway Labor Act as amended.

Supply Trade Notes

The Superior Hand Brake Company, Chicago, has moved its offices to the Railway Exchange Building.

H. W. Porter & Co., Inc., Newark, N. J., has been appointed distributor in the Newark area for the General Refractories Company, Philadelphia, Pa.

The T-Z Railway Equipment Company, Chicago, has moved its offices from 310 South Michigan avenue to 8 South Michigan avenue.

R. B. Hill, a representative of the Lewis Bolt & Nut Company, Minneapolis, Minn., has opened an office at 516 Railway Exchange building, Chicago.

Pierce T. Wetter, vice-president of American Cutting Alloys, Inc., has announced the appointment of Dr. Ing. Paul Schwarzkopf of Reutte, Austria, as the president of the company.

Charles S. Payson, of New York, has been elected a director of The American Rolling Mill Company, Middletown, Ohio. Mr. Payson is also a director of the Rustless Iron Corporation, Baltimore, Md.

Charles R. Hook, president of the American Rolling Mill Company, Middletown, Ohio, has been elected a director of the Rustless Iron & Steel Corporation, Baltimore, Md. The American Rolling Mill Company, which recently acquired an interest of approximately 48 per cent in Rustless Iron & Steel Corporation, is also represented on the board by Calvin Verity, executive vice-president, and W. W. Sebald, vice-president.

E. T. Schroeder, 1205 Syndicate Trust building, St. Louis, Mo., has been appointed sales agent for the Eagle-Picher Sales Company, Cincinnati, Ohio, representing its line of insulating products for railway sales in St. Louis and the Southwest.

J. J. Davis, Jr., sales engineer of the Carnegie-Illinois Steel Corporation at Chicago, has been appointed assistant manager of sales of the railroad materials and commercial forgings division with headquarters at Chicago. Mr. Davis was born on August 3, 1894, at White Pigeon, Mich., and after attending Purdue University and Armour Institute of Technology entered the employ of the Chicago, Burlington & Quincy as a rodman, which position he held from June, 1913, to September of that year. He then entered the employ of the Elgin, Joliet & Eastern at Gary, Ind., where he was a rodman, instrumentman, assistant engineer and supervisor of track during the period until February 15, 1935. On the latter date he entered the general sales department of the Illinois Steel Company, now the Carnegie-Illinois Steel Corporation, as a sales engineer.

(c) Moffett Studio

J. J. Davis, Jr.

The Watson-Stillman Company has opened a sales office at 83 South High street, Columbus, Ohio. John C. Grindlay is in charge of this office, and will cover the Kentucky, Southern Ohio and Southern Indiana territory. Richard W. Dinzl has been appointed chief engineer of the Watson-Stillman Company, with headquarters at the main office, Roselle, N. J. Mr. Dinzl recently resigned from the Baldwin Southwark Company, where he had been in charge of engineering for the Southwark division of that company.

H. F. Henriques and J. J. Lincoln, Jr., have been appointed assistant general sales managers of the Air Reduction Sales Company, with headquarters at Cleveland, Ohio, and Pittsburgh, Pa., respectively. Mr. Henriques has been a member of the sales department since March, 1929, and was manager of the Cleveland district from January, 1934, until he assumed his new position in January, 1937. Mr. Lincoln joined the company in 1924 and was appointed manager of the Pittsburgh district

(Continued on next left-hand page)

in May, 1934. J. M. Driscoll has been appointed acting manager at Cleveland. Mr. Driscoll has been in the service of Airco since March, 1929, when he joined the sales department. In 1933 he was appointed assistant sales manager of the Cleveland district, which position he has held until his recent appointment as assistant general sales manager. S. D. Edsall has been appointed acting district manager of the Pittsburgh district. Mr. Edsall has been with the Airco sales department since February, 1923, and has been assistant sales manager of the Pittsburgh district since July, 1925. J. F. Pryor, formerly assistant to the general sales manager, has been appointed vice-president of the Magnolia Airco Gas Products Company, a Texas corporation handling all of Air Reduction's activities within that state. Mr. Pryor will have his headquarters at Houston, Texas.

A. Van Hassel, vice-president of the Magor Car Corporation, New York, has been elected president. L. C. Haigh, secretary, and J. W. Leis, plant manager, have been elected vice-presidents, and W. P. Smith and R. C. Warburton, of the general staff, have been elected secretary and treasurer, respectively, all with headquarters at New York, except Mr. Leis, who will be located at Passaic, N. J.

A. Van Hassel was born on November 12, 1889, at Paterson, N. J. He was educated in the grammar and high schools of that city, and then was in the service of the Rogers Locomotive Works. He subsequently served with the Cooke Locomotive Works, in Paterson, N. J., and since 1909

Blank & Stoller
A. Van Hassel

has been associated with the Magor Car Corporation, serving in various capacities, until 1921 when he was elected secretary. In March, 1925, he became vice-president, secretary-treasurer; in 1929, he relinquished the office of secretary. Mr. Van Hassel is also assistant secretary and assistant treasurer of the National Steel Car Corporation, Hamilton, Ont.

Lewis C. Haigh was born in Brooklyn, N. Y., on January 30, 1898. He received his education in the public schools of New York and East Orange and prepared for college at the St. Paul Academy, St. Paul Minn. He also attended Wharton School, University of Pennsylvania, for two years. Mr. Haigh entered the service of the Magor Car Corporation early in 1922 in the shops at Passaic, N. J., and one year later joined its sales force in the New York office. Since October, 1929, he served as secretary of the corporation.

James W. Leis began his career in the steel car business 36 years ago. He served with the Pressed Steel Car Company in Pittsburgh, Pa., for five years, later at that company's Chicago plant for two years and then in Canada with the Canadian Car & Foundry Company. In 1910 he was appointed plant manager.

Edward W. Leahey has been appointed district sales manager of the Ohio Brass Company to serve power utilities, transit companies and steam railroads in Virginia, West Virginia and lower Maryland. Mr. Leahey's headquarters will be in Philadelphia, Pa.

The Bantam Ball Bearing Company, South Bend, Ind., has changed its name to the Bantam Bearings Corporation to describe more clearly its products which include, in addition to ball bearings, taper roller and straight roller bearings. The Bantam Bearings Corporation is now a subsidiary of the Torrington Company, Torrington, Conn.

J. L. Terry, vice-president of the Q & C Company, New York, has been elected president of the company, succeeding F. F. Kister, who was president and treasurer. Mr. Kister has been elected chairman of the board of directors, also retaining the title of treasurer. Both men, as formerly, will have headquarters at New York.

The Oster Manufacturing Co., Cleveland, Ohio, has appointed R. B. Tewksbury, chairman of the board; Roger Tewksbury, president and treasurer; Arthur S. Gould vice-president, and Harry A. Maurer secretary. The first two officers were formerly president, vice-president and secretary, respectively, while Mr. Maurer was general superintendent of the company's plants at Erie, Pa., and Cleveland, Ohio.

John M. Schreiner has been appointed manager of the Detroit, Mich., branch of the Black & Decker Manufacturing Co., Towson, Md., succeeding the late George W. Stoiber. Mr. Schreiner has been active in the Detroit area for the past 12 years. W. J. Fenwick, who for several years has been co-manager of the Cleveland, Ohio, territory, has been appointed manager of all activities in that branch, and G. H. Treslar has been appointed supervisor of the Detroit and Cleveland territories, co-operating with Messrs. Schreiner and Fenwick in the promotion of sales in these areas.

John Graham Morrissey has been appointed sales manager, eastern district, of the Pressed Steel Car Company, Inc., with headquarters at New York. Mr. Morrissey was born at St. Paul, Minn., and attended the University of Minnesota, leaving there to serve in the United States Army during the World War. On his discharge, in 1920, he was employed in the operating department of the Pressed Steel Car Company, at McKees Rocks, Pa. A year later he was transferred to the sales department at New York, where he has been up to the present time.

John May, assistant general manager of sales in charge of electric cables and wire rope of the American Steel & Wire Company, with headquarters at Worcester, Mass., has been appointed general manager of sales, with headquarters at Cleveland, Ohio, Dennis A. Merriman having relinquished his title and duties as general

John May

sales manager but continuing as vice-president. Mr. May entered the employ of this company in 1909 in the order department of the New York sales office. He was transferred to Worcester, Mass., and after a short time returned to New York, where, after several promotions, he became, in 1921, manager of sales of electric wire and wire rope. In 1931 he was appointed assistant general manager of sales of electric wire and wire rope for the entire country, with headquarters at Worcester.

Obituary

Edwin J. Rooksby of E. J. Rooksby & Co., Philadelphia, Pa., died on March 17.

Edward P. Burrell, director of engineering of the Warner & Swasey Company, Cleveland, Ohio, died on March 21 at the age of 66.

Frank J. Bauman, steel tool sales manager of the Republic Steel Corporation, died on February 24 at Cleveland, Ohio.

Harold Francis Lane, Washington editor of the *Railway Mechanical Engineer* and other Simmons-Boardman publications since 1916, died of a heart ailment on February 27 at his home in that city. He was 54 years of age. Mr. Lane was born November 2, 1882, at Ashburnham, Mass., and attended the public schools there and at St. Paul, Minn., and Chicago. After being graduated from Calumet High School, Chicago, in 1901, he entered Dartmouth College where he was awarded an A.B. degree in 1905. In the same year he entered the editorial department of the

(*Continued on next left-hand page*)

former Railway Age then published by the Wilson Company, Chicago. In 1906 he was transferred to the Electric Railway Review, also published by the Wilson Com-

H. F. Lane

pany. After two years in the latter position, Mr. Lane became railroad editor of the Chicago Tribune, a position he held for four years. Meanwhile the original Railway Age had been consolidated with the Railroad Gazette into the Railway Age Gazette, under Simmons-Boardman ownership, and Mr. Lane in January, 1912, became associate editor of the Railway Age Gazette at Chicago. In September, 1916, he was transferred to Washington. While in the Chicago office Mr. Lane edited the 1913 edition of the Biographical Directory of Railway Officials (now Who's Who in Railroading). He was a member of the National Press Club, the White House Correspondents' Association, both of Washington, and the Dartmouth College Club of New York.

OTTO BEST, who retired five years ago as superintendent and general manager of the Nathan Manufacturing Company's locomotive appliance factory, died on March 4, in St. Vincent's Hospital, New York, at the age of 70 years. Mr. Best, for many years, prior to his association with the Nathan Manufacturing Company, was air brake instructor of the Nashville, Chattanooga & St. Louis. He was also a past president and, for many years, until the time of his death, was treasurer of the Air Brake Association.

RALPH ATLEE LIGHT, vice-president and secretary of the U. S. Metallic Packing Company, died suddenly on March 2, at Philadelphia, Pa. Mr. Light was born on November 3, 1892, at Wilmington, Del. He was educated in the public schools and the Drexel Institute in Philadelphia, and in the United States Naval Academy. Mr. Light entered the employ of the United

Ralph Atlee Light

States Metallic Packing Company on April 13, 1905. He became secretary of the company on February 9, 1920, and was elected vice-president on February 19, 1934.

Personal Mention

General

RALPH SIMPSON, mechanical engineer of the Minneapolis, St. Paul & Sault Ste. Marie, has been appointed to the newly created position of assistant to the vice-president and general manager, with headquarters as before at Minneapolis, Minn. Mr. Simpson has been in railway service

Ralph Simpson

for 30 years. He was born on December 26, 1892, at Stratford, Ont., and first entered railway service with the Grand Trunk (now Canadian National) in September, 1907, as a special apprentice. From March, 1913, to March, 1916, he served in the mechanical engineer's office of the Grand Trunk Pacific, then entering the service of the Soo Line as a mechanic. Following a year in the latter capacity Mr. Simpson joined the Northern Pacific, where he served as a draftsman until July, 1917, when he returned to the Soo Line as chief draftsman. In February, 1923, he was appointed mechanical engineer of the Soo Line.

S. H. BARNHART, assistant to comptroller of the Norfolk & Western at Roanoke, Va., has been appointed assistant comptroller, with headquarters at Roanoke. Mr. Barnhart was born at Shepherdstown, W. Va., and is a graduate of Shepherd College He entered the service of the Norfolk & Western in 1905 in the Roanoke shops and since that time has served successively as machinist apprentice, assistant engineer of tests, wheel shop foreman, engine inspector, assistant enginehouse foreman and assistant valuation engineer In June, 1929, he was appointed assistant valuation engineer in the valuation department and on August 1, 1933, became engineering assistant to the comptroller. Mr. Barnhart was appointed assistant to the comptroller on December 1, 1935.

S. H. Barnhart

G. P. TRACHTA, division master mechanic of the Chicago, Burlington & Quincy at St. Joseph, Mo., has been appointed district superintendent of motive power of the Chicago, Rock Island & Pacific, with headquarters at Kansas City,

Gerald P. Trachta

Mo. Mr. Trachta was born on October 5, 1883, at Schuyler, Neb. He first entered railway service on December 19, 1901, as an enginehouse sweeper on the Chicago, Burlington & Quincy at Sheridan, Wyo., later becoming a machinist helper and then machinist. He entered engine service

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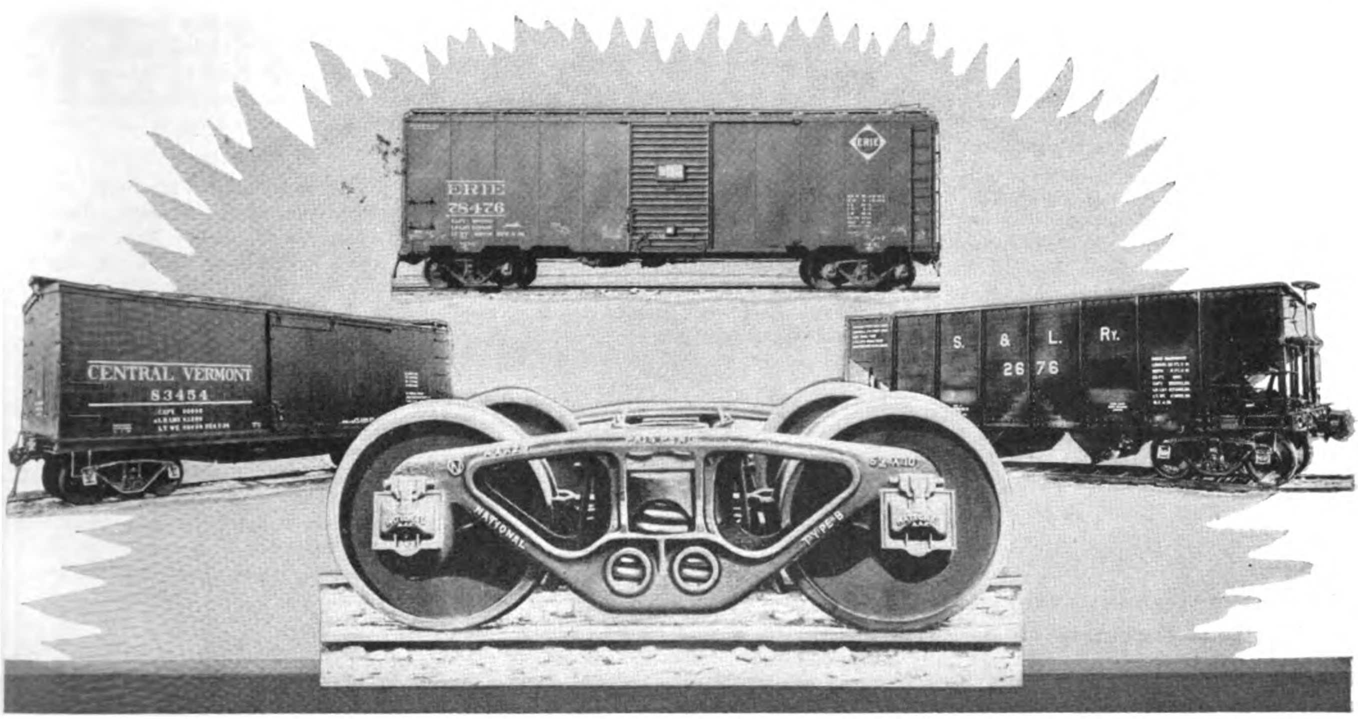
ERIE
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on March 10, 1903, as a locomotive fireman, being promoted to locomotive engineer on October 5, 1905, and to road foreman of engines on the Sheridan division October 1, 1910. Seven years later he become master mechanic of the Casper division, resigning on December 1, 1919, to accept a position as road foreman of engines on the Arizona Eastern (now part of the Southern Pacific), at Phoenix, Ariz. On March 1, 1923, Mr. Trachta returned to the Burlington as enginehouse foreman at Wymore, Neb., being appointed general foreman at Kansas City, Mo., on August 1, 1923, and master mechanic at Omaha, Neb., on August 1, 1925. Subsequently he was transferred to Galesburg, Ill., and thence to St. Joseph, Mo., being located at the latter point at the time he resigned to enter the service of the Rock Island as district superintendent motive power at Kansas City.

Master Mechanics and Road Foremen

B. R. Carson has been appointed assistant road foreman of engines of the Philadelphia division of the Pennsylvania.

P. R. Logue has been appointed assistant road foreman of engines of the Baltimore division of the Pennsylvania.

C. L. Patterson has been appointed acting assistant master mechanic of the Eastern division of the Pennsylvania, succeeding B. G. Gibson.

W. P. Primm, assistant road foreman of engines of the Baltimore Division of the Pennsylvania, has been appointed assistant foreman of engines, Pan Handle division.

W. G. Wilson has been appointed acting master mechanic of the Illinois and Missouri divisions and the DuPo Terminals of the St. Louis Terminal division of the Missouri Pacific and of the Missouri-Illinois Railroad (part of the Missouri Pacific), with headquarters at DuPo, Ill., to succeed W. C. Smith, who has been granted a leave of absence.

W. B. Embury, master mechanic of the Chicago, Rock Island & Pacific at Armourdale, Kan., has been transferred to Little Rock, Ark., succeeding R. C. Hyde.

A. R. Ruiter, master mechanic of the Chicago, Rock Island & Pacific at Shawnee, Okla., has been transferred to Armourdale, Kan., where he succeeds W. B. Embury.

L. D. Richards, superintendent motive power of the Chicago, Rock Island & Pacific with headquarters at Kansas City, Mo., has been appointed master mechanic at Shawnee, Okla.

M. W. DeWitt, road foreman of engines of the Logansport division of the Pennsylvania, has been appointed road foreman of engines, Toledo division, with headquarters at Toledo, Ohio.

G. B. Pauley, master mechanic of the Alliance division of the Chicago, Burlington & Quincy, has been transferred to the St. Joseph division, with headquarters at St. Joseph, Mo.

J. D. Scott, trainmaster of the Columbus division of the Pennsylvania, has been appointed road foreman of engines, Logansport division, with headquarters at Logansport, Ind.

J. W. West, assistant road foreman of engines of the Philadelphia division of the Pennsylvania, has been appointed assistant road foreman of engines, Conemaugh division.

R. C. Hyde, master mechanic of the Chicago, Rock Island & Pacific at Little Rock, Ark., has been appointed assistant master mechanic at Fort Worth, Tex.

J. S. Williams, general foreman of the Chesapeake & Ohio at Charlottesville, Va., has been appointed master mechanic of the Richmond division, with headquarters at Richmond, Va., succeeding W. P. Hobson, deceased.

C. J. Dietrich, master mechanic of the McCook division of the Chicago, Burlington & Quincy at McCook, Neb., has been transferred to Alliance, Neb. as master mechanic of the Alliance division, including the lines from Alliance to Sterling and from Northport, Neb., to Guernsey, Wyo., on the Sterling division.

E. J. Cyr, general foreman of the Chicago, Burlington & Quincy at Chicago, has been appointed master mechanic of the McCook division, with headquarters at McCook, Neb., where he will also have jurisdiction over the lines from Holdrege, Neb., to Cheyenne, Wyo., and from Sterling, Colo., to Brush, including the Sterling terminal.

Shop and Enginehouse

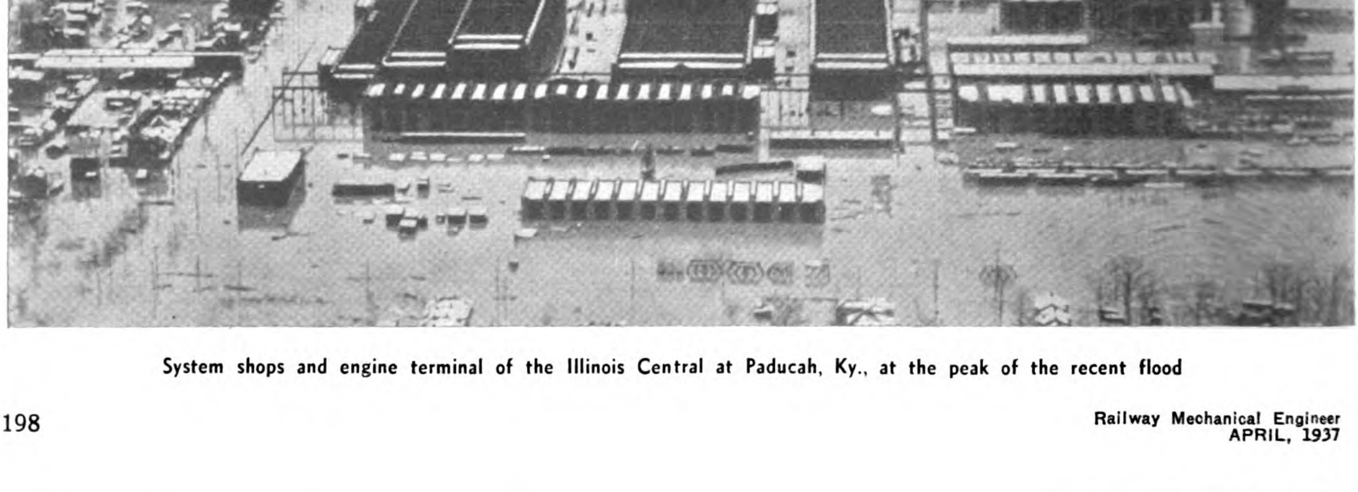
J. W. Bailey, general foreman of the Montreal shop of the Canadian National, has been appointed superintendent of the Point St. Charles shops, with headquarters at Montreal, Que., succeeding Alexander McDonald, deceased.

F. B. Downey, general foreman of the Chesapeake & Ohio at Huntington, W. Va., has been appointed assistant shop superintendent, with headquarters at Huntington. The position of general foreman has been abolished.

Obituary

Alexander McDonald, superintendent of the Point St. Charles shops of the Canadian National, with headquarters at Montreal, Que., died at his home on February 27, after an illness of a few months. Mr. McDonald was 49 years old.

* * *



System shops and engine terminal of the Illinois Central at Paducah, Ky., at the peak of the recent flood

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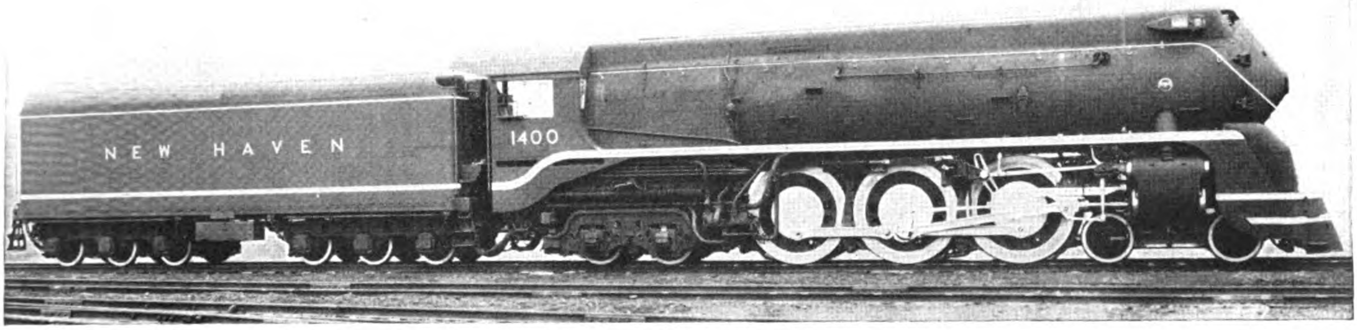
RAILWAY MECHANICAL ENGINEER



New York, New Haven & Hartford high-speed passenger locomotive

New Haven

Streamline Locomotives

Baldwin-built 4-6-4 type passenger engines have 80-in. drivers. The total weight on drivers is 193,000 lb. and the tractive force, 44,000 lb. The ten locomotives are intended to handle a large part of the mainline through passenger service

THE New York, New Haven & Hartford has recently received ten streamline 4-6-4 type passenger locomotives from the Baldwin Locomotive Works. These locomotives, to be known as the Shore Line type, are designed for high-speed service, and with capacity sufficient to handle passenger trains of 15 cars on fast schedules.

These locomotives have a total weight on drivers of 193,000 lb., with a combined heating surface of 4,857 sq. ft. and a grate area of 77.1 sq. ft. The cylinders are 22 in. by 30 in. diameter and the driving wheels, 80 in. diameter. With a boiler working pressure of 285 lb. per sq. in., the tractive force rating is 44,000 lb.

The Boiler

The boiler is of the conical type and the horizontal mud ring is supported by four sliding furnace bearers. The working pressure is 285 lb., but it is designed for a maximum working pressure of 300 lb. The barrel sheets, the wrapper sheet, the back head and throat sheet are of nickel steel. The firebox sheets are of deoxidized steel produced by the silicon-aluminum process. The firebox is 132 in. long by 84⅛ in. wide at the grate and includes a 42-in. combustion chamber. The tubes are 18 ft. long. The Type A superheater includes an American multiple throttle in the header.

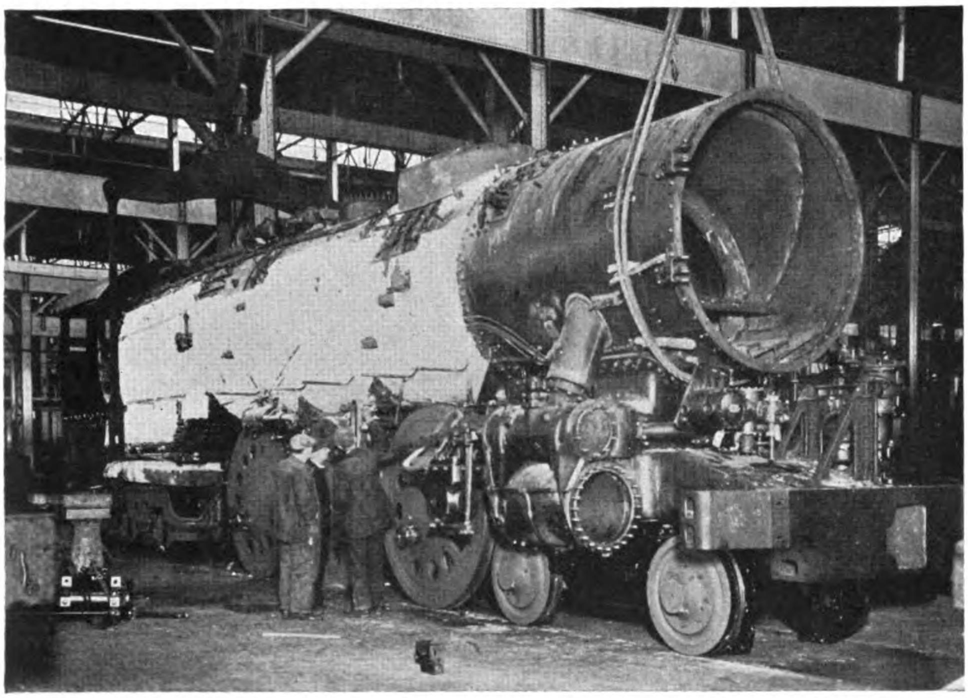
The firebox sheets are completely welded. Seal welding is also employed at the mud-ring corners, at the lower ends of the vertical wrapper-sheet seams, at the ends of longitudinal barrel seams and behind pad locations. Alco flexible staybolts are applied in the breaking zones and there is a complete installation in the water space around the combustion chamber and on the throat sheet.

The firebox is fitted with Firebar grates and coal is fed by a Standard Type HT stoker, the engine of which is located in a compartment in the left front corner of the tender. The ash pans are of cast steel. Other boiler appliances include the Hancock Turbo-Injector, the Barco Type F4a low-water alarm and the Dri Steam steam separator. The locomotives are fitted with the Master Mechanics' front end.

Frames and Running Gear

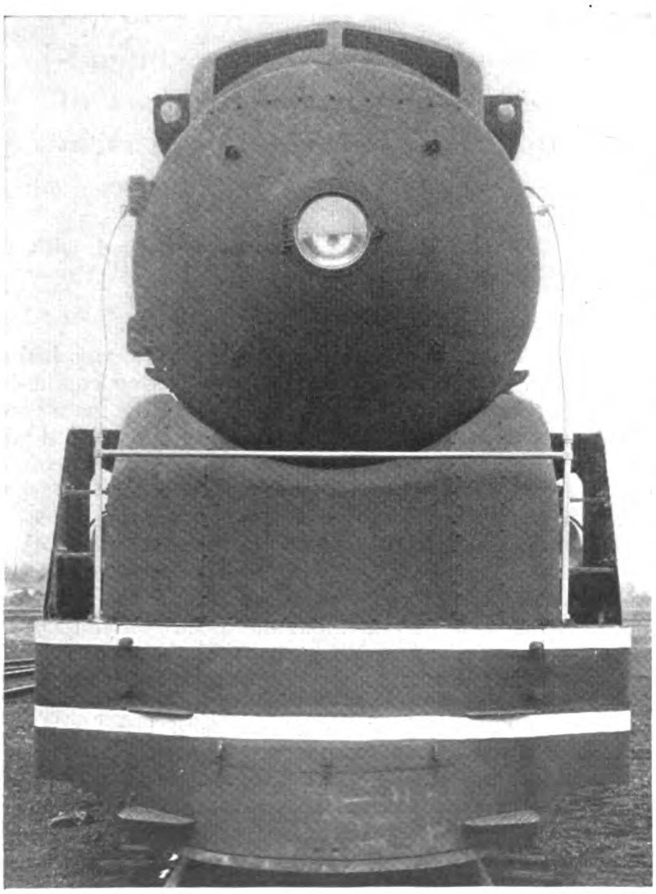
These locomotives are of rugged design and include many modern details. The foundation is an engine-bed casting, of which the cylinders and saddle, the main reservoir and various attachment brackets are an integral part. The running gear of these locomotives consists of the Boxpok driving wheels mounted on axles of carbon-vanadium steel. The journals of five locomotives are fitted with Timken roller-bearing driving boxes and the journals of the other five with SKF roller-bearing driving boxes. The crank pins, as well as the main and side rods, are also of carbon-vanadium steel. Advantage has been taken of the physical properties of this material in a 10-per cent increase in connecting-rod working stress over that normal for carbon steel. Floating bushings are fitted in the back end of the main rod and in the main side-rod connection. The outer bushings are of gun iron, with bronze inner bushings.

The engine and trailer trucks are General Steel Castings type. The front truck is fitted with the constant-resistance centering device. The lateral displacement has



Wheeling one of the locomotives in the erecting shop

an initial resistance of 40 per cent and a constant resistance of 33⅓ per cent. This truck has inboard bearings. The trailer truck has an initial and constant lateral resistance of 15 per cent. Both trucks are fitted with American Steel Foundries roller-bearing wheel-and-axle assemblies with SKF bearings. The cylinders are an integral part of the bed casting and all cylinder heads are steel, cast separately. The piston valves are 11 in. in diameter. The rear valve chamber heads are cast steel; for front heads, however, the material is cast iron.



On five of the locomotives the pistons are of Baldwin design fitted with Hunt-Spiller gun-iron bull rings and Duplex packing rings, while on the other five locomotives the piston heads are the Locomotive Finished Material type with bronze rings. Hunt-Spiller Duplex sectional type valve rings and gun-iron valve and cylinder bushings are fitted on all of the locomotives. The single-bar guide and crosshead are of the multi-ledge type.

Steam distribution is effected by the Walschaert valve motion controlled by the Barco Type M-1 power reverse gear. With the small valve diameter the load on the parts is reduced to a minimum and the valve-motion presents an unusually light appearance. The link trunnions are mounted in needle type roller bearings.

Each locomotive has two force-feed lubricators. On five of the locomotives Nathan DV4 20-pint lubricators are installed and on the others 24-pint Detroit Model A. The right lubricator dispenses valve oil and that on the left side is for car oil.

The five feeds from the right lubricator lead to the cylinders, steam chest and the stoker engine. Five feeds lead from the left side lubricator. Three of these lead to the driving-box pedestals, the oil being distributed to each pair of pedestals through a four-way divider; one feed, using a four-way divider, lubricates the main guides, and one feed, also through a divider, lubricates the valve-stem guides. A Westinghouse mechanical lubricator is furnished for the air compressor. Alemite lubrication is provided for the furnace bearers, front truck center casting, and the spring rigging and the brake rigging on the locomotive and tender.

The Tender

The tender is built-up on a General Steel Castings water-bottom frame. The frame is arranged to furnish access to the rear of the stoker feed trough from underneath the tender.

The tender tank is of riveted construction. The principal materials of construction are Cor-Ten steel plates and structural sections of copper-bearing steel. In the coal space, however, wrought-iron plates are used.

The tender trucks are of the six-wheel type, of cast-steel construction, with 6½-in. by 12-in. journals. Isothermos journal boxes are used. The wheels are 36 in.

in diameter, of rolled steel on eight tenders and cast steel on the other two tenders. The trucks are fitted with Simplex unit-cylinder clasp brakes.

The locomotives are equipped with Westinghouse No. 8ET air brakes, operating on all wheels, except the engine truck. They are also fitted with cab signals, furnished by the Union Switch & Signal Company on five locomotives and by the General Railway Signal Company on the other five.

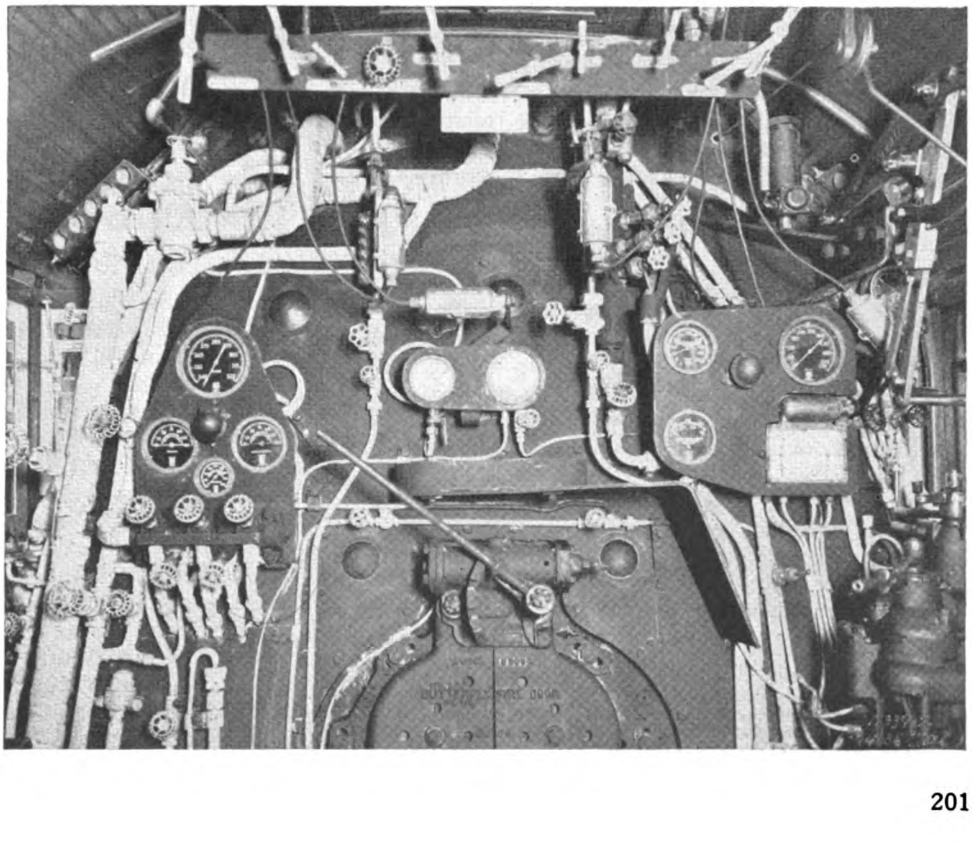
The Streamlining

The locomotives present a clean-cut appearance. All projections above the top of the boiler are housed within a shrouding which is flush with the top of the cab at the rear and with the top of the stack at the front. The boiler front is enclosed within a conical shrouding, in the apex of which is the headlight. The space between the smokebox and the front bumper is completely enclosed, as is also the pilot. The locomotive and tender are finished in black with striping of aluminum paint or stainless-steel. The large disc centers of the Boxpok driving wheels and the rims and tires are also finished in aluminum. There is a 6-in. stainless-steel strip edging the running boards. The air-brake radiator pipes are located over the top of the engine bed so that the sides of the locomotive are free from unsightly lines.

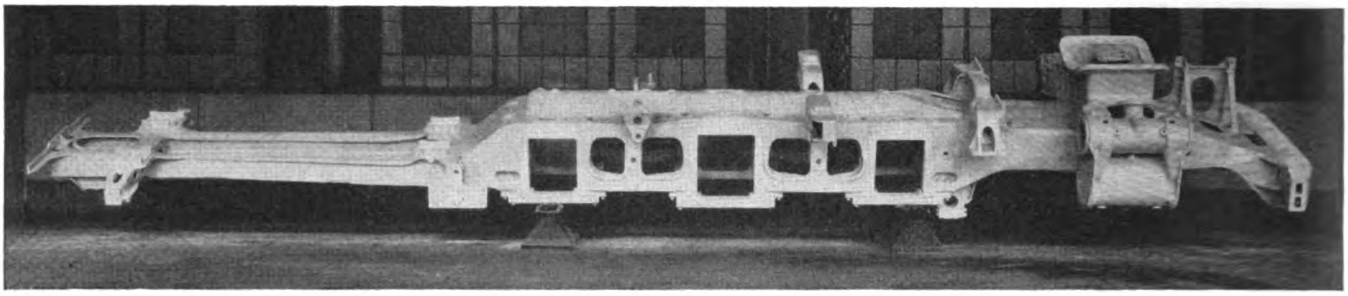
The smokebox is closed with the usual type of hinged front with a central door opening. At the base of the

General Dimensions, Weights and Proportions of the N.Y. N.H. & H. 4-6-4 Type Passenger Locomotives

Railroad	N. Y. N. H. & H.
Builder	Baldwin Locomotive Works
Type of locomotive	4-6-4 (Streamline)
Road class	1—5
Road numbers	1400—1409
Date built	1937
Service	Passenger
Dimensions:	
Height to top of stack, ft. and in.	15—4
Height to center of boiler, ft. and in.	10—6
Width overall, in.	124
Cylinder centers, in.	89
Weights in working order, lb.:	
On drivers	193,000
On front truck	71,500
On trailing truck	100,800
Total engine	365,300
Tender	332,000
Wheel bases, ft. and in.:	
Driving	14—0
Rigid	14—0
Engine, total	40—1
Engine and tender, total	84—10
Wheels, diameter outside tires, in.:	
Driving	80
Front truck	36
Trailing truck	42
Engine:	
Cylinders, number, diameter and stroke, in.	22 x 30
Valve gear, type	Walschaert
Valves, piston type, size, in.	11
Maximum travel, in.	7½
Steam lap, in.	1 5/16
Exhaust clearance, in.	⅛
Lead, in.	5/16
Boiler:	
Type	Conical
Steam pressure, lb. per sq. in.	285
Diameter, first ring, inside, in.	82 7/16
Diameter, largest, outside, in.	93
Firebox, length, in.	132
Firebox, width, in.	84⅛
Height mud ring to crown sheet, back, in.	84 1/16
Height mud ring to crown sheet, front, in.	97 9/16
Combustion chamber length, in.	42
Thermic syphons, number	3
Tubes, number and diameter, in.	199—2¼
Flues, number and diameter, in.	48—5½
Length over tube sheets, ft. and in.	18—0
Fuel	Soft coal
Stoker	Standard Type HT
Grate type	Firebar
Grate area, sq. ft.	77.1
Heating surfaces, sq. ft.:	
Firebox and comb. chamber	341
Thermic syphons	139
Firebox, total	480
Tubes and flues	3,335
Evaporative, total	3,815
Superheating (Type A)	1,042
Combined evap. and superheat	4,857
Feedwater heater, type	Hancock Turbo Injector
Tender:	
Style or type	Water bottom
Water capacity, U. S. gal.	18,000
Fuel capacity, tons	16
Trucks	6-wheel
Journals, dia. and length, in.	6½ x 12
General Data, estimated:	
Rates tractive force, lb.	44,000
Weight Proportions:	
Weight on drivers ÷ weight, engine, per cent.	52.9
Weight on drivers ÷ tractive force	43.9
Weight of engine ÷ comb. heat surface	75.2
Boiler Proportions:	
Firebox h.s. per cent comb. h.s.	9.8
Tube-flue h.s. per cent comb. h.s.	68.4
Superheat surface per cent comb. h.s.	21.8
Firebox h.s. ÷ grate area	6.2
Tube-flue h.s. ÷ grate area	43.2
Superheat. surface ÷ grate area	13.5
Comb. h.s. ÷ grate area	62.9
Tractive force ÷ grate area	570.7
Tractive force ÷ comb. h.s.	9.06
Tractive force x dia. drivers ÷ comb. h.s.	724.7



The cab interior presents an orderly arrangement of piping



The bed casting of the New Haven streamline locomotives

cone, the front-end shrouding is welded continuously to the smokebox front and will swing out with it. The apex portion of the cone is a separate piece which is hinged inside and held in place by four clamps. By releasing the clamps it can be swung to one side to give access to the front-end door.

The enclosed space under the front-end conceals the 8½-in. cross-compound compressor, the bell and the heater portion of the Turbo-Injector. The coupler is hinged vertically and when swung back to one side is concealed by a hinged dropdoor in the pilot shrouding.

Back of the front end, the principal feature of the streamlining is the shrouding which encloses all of the customary projections above the top of the boiler. This is mounted above the usual boiler jacket, is 5 ft. 8 in. in width, and up to the top clearance line in height. This shrouding is built-up on a series of transverse frames of light flat sections, stiffened at the corners with gussets which are welded in place. Light angles are applied longitudinally to the under side of the sheathing. From a point about 3 ft. ahead of the cab to the rear of the smoke lifter a width of 3 ft. on the top of the housing is covered with Diamondette foot plate. Wells are provided for the safety valves, and a suitable hatch furnishes access to the sand box. In addition to the sand box this shrouding conceals the dome, the low-water alarm and the single saturated-steam turret. The smoke lifter, which completely encloses the stack, has louver openings in front and a wide horizontal slot in the top of the casing at the rear of the stack.

The principal dimensions and weights are shown in the accompanying table.

U. P. to use Steamotive Units for

Turbo-Electric Locomotive*

Two light-weight boilers of wide-range capacity designed by Babcock & Wilcox with control apparatus by the Bailey Meter Company for a 5,000 hp. turbo-electric locomotive being built by the General Electric Company

Two light-weight steam generating units each with a rating of 2,500 hp. and with an output of 40,000 lb. of steam per hr. at a pressure of 1,500 lb. per sq. in. and a temperature of 950 deg. F. has been built by the Babcock & Wilcox Co. for a turbo-electric locomotive which is being built by the General Electric Co. for the Union Pacific. The control apparatus for the unit is furnished by the Bailey Meter Co. This unit is called "Steamotive" and is so designed that steam generation can be controlled automatically to respond quickly to wide variations in load, which feature is required to meet locomotive power demands.

The locomotive will be a double-cab unit with a 5,000 hp. rating and will be used to haul 1,000-ton trains such as the Union Pacific "Challenger" or the "Los Angeles Limited" over the Los Angeles-Omaha route. The locomotive will be streamlined, practically smokeless, and provided with equipment for air conditioning. It is expected that it will attain speeds of 110 m.p.h. on level track. Electric power will drive traction motors constructed on the usual type of electric-locomotive design.

The objects to be attained in the construction of this complete portable steam power plant are: (1) High steam pressure and temperature; (2) minimum weight and size per unit of steam produced; (3) wide range of capacity with ability of the unit to respond quickly to wide variations in load conditions; (4) adaptability to wide range of fuels; (5) completely coordinated auxiliaries; (6) completely coordinated automatic control, and (7) simple design, constructed in sizes small enough to be portable.

Following preliminary work done jointly by the Babcock & Wilcox Company, General Electric Company and Bailey Meter Company to confirm the possibilities of the Steamotive units, a developmental steam-generating unit was built and put in operation to perfect the design of the various component parts under actual operating conditions. The developmental Steamotive unit was assembled in the General Electric works at Schenectady, N. Y., during the latter part of 1934. The Steamotive boiler was designed and built by the Babcock & Wilcox Company, at Barberton, Ohio. It was oil-fired and designed for an output of 21,000 lb. of steam per hr. at a pressure of 1,500 lb. and a temperature of 1,050

* Abstract of paper presented by E. G. Bailey of the Babcock & Wilcox Company, A. R. Smith of the General Electric Company, and P. S. Dickey of the Bailey Meter Company before the 1936 annual meeting of the American Society of Mechanical Engineers.

deg. F. leaving the superheater, later changed to 900 deg. F. These specifications conformed to the requirements of a turbo-electric locomotive.

The Steamotive auxiliary set was designed and built

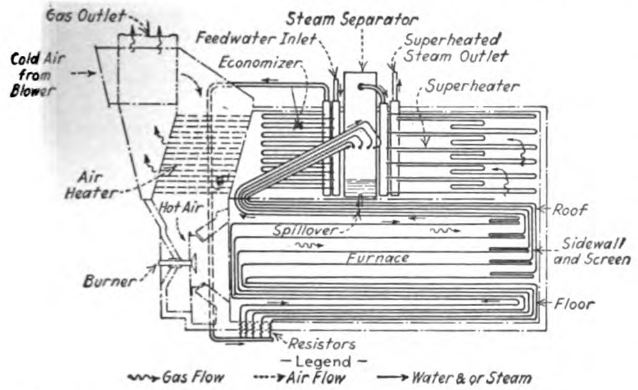


Fig. 1—Flow diagram of the developmental Steamotive unit

by General Electric Company. These auxiliaries, geared together as one turbine-driven unit, consist of a feed pump which delivers 25,000 lb. of water per hour at a pressure of 2,000 lb.; a blower for 30,000 lb. air per hour at a pressure of 60 in. of water; a fuel-oil pump; and a lubricating-oil pump.

The meters and complete automatic control, designed and built by the Bailey Meter Company, coordinate the auxiliaries and the supply of fuel, air and feedwater to control steam output, pressure and temperature, together with complete automatic ignition and safety equipment.

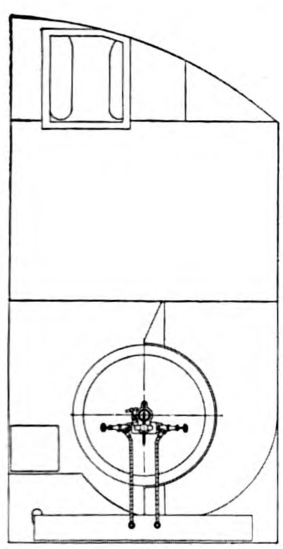
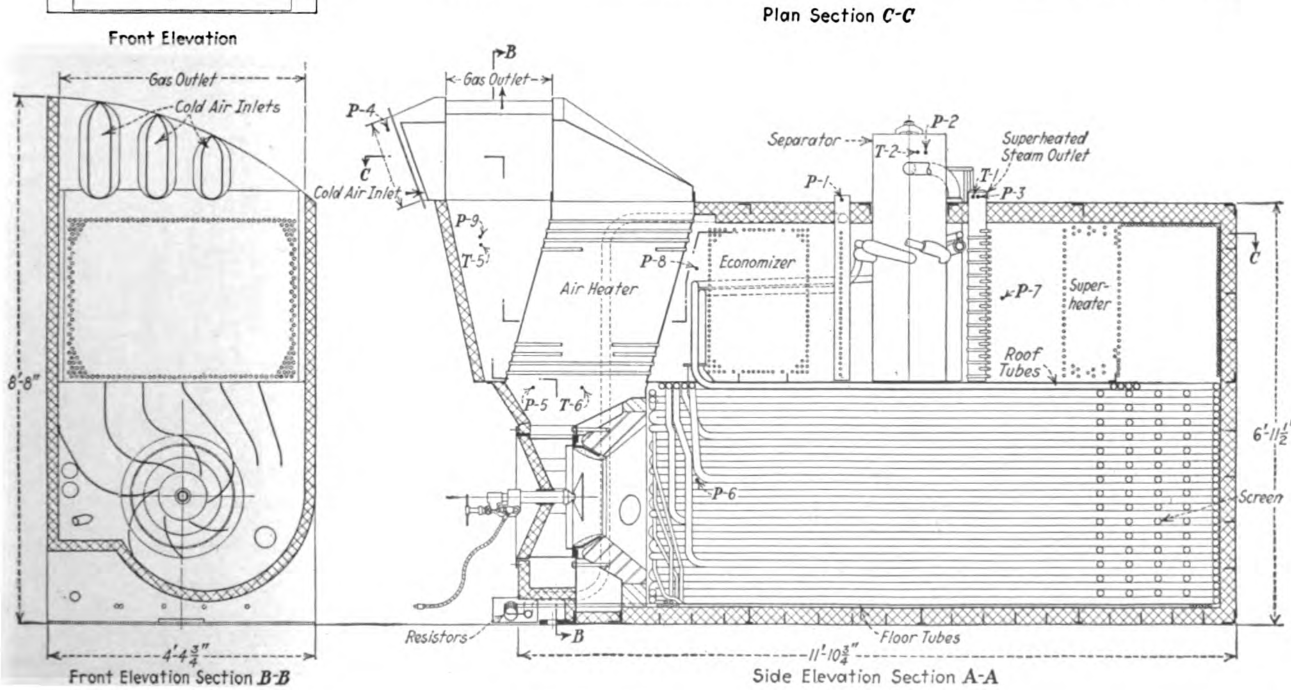
No serious defects were encountered in any of this equipment. During tests the complete unit operated 950 hrs., much of which time was continued maximum rating with long periods under extremely variable load conditions such as would be encountered in regular locomotive road service. The combustion of oil exceeded 400,000 B.t.u. per cu. ft. per hr. on peaks and 375,000 B.t.u. under continuous load. The unit operated over a range of output of 10 to 1 under complete automatic control. This Steamotive unit is now in commercial service in the Lynn Works of the General Electric Company.

Installation of Developmental Steamotive Unit

The first developmental Steamotive unit was assembled at the Schenectady Works of the General Electric Company for test. The intention was that two similar units would be installed in the cab of the 5,000-hp. Union Pacific steam-electric locomotive. The shape and dimensions of the boiler were determined by the proposed locomotive design, which at that time required the boiler to be wholly above the frame, thus necessitating a horizontal boiler.

The flow diagram of the developmental unit is shown in Fig. 1, and the details of construction in Fig. 2. The

Fig. 2—Details of construction of the developmental Steamotive unit

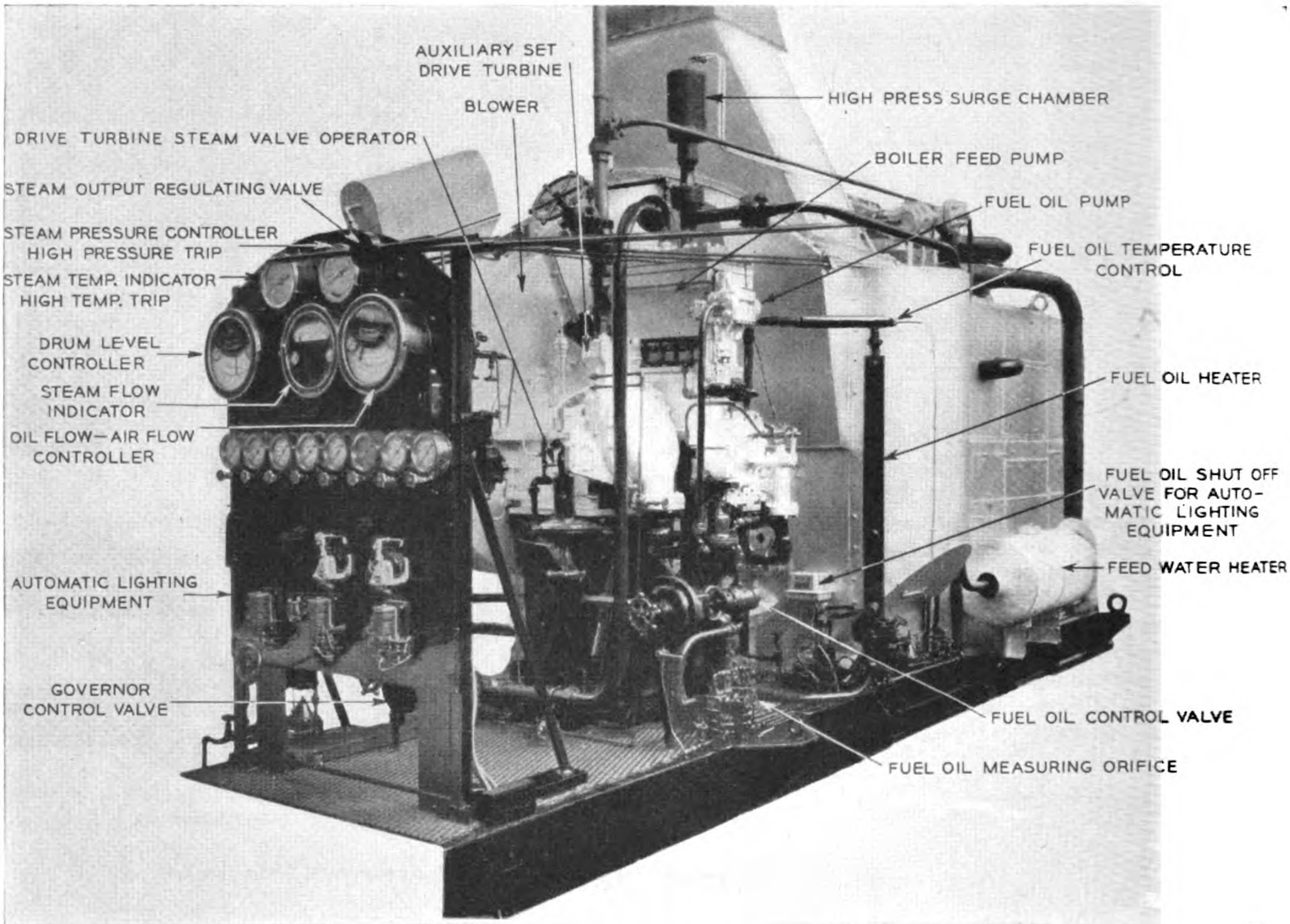
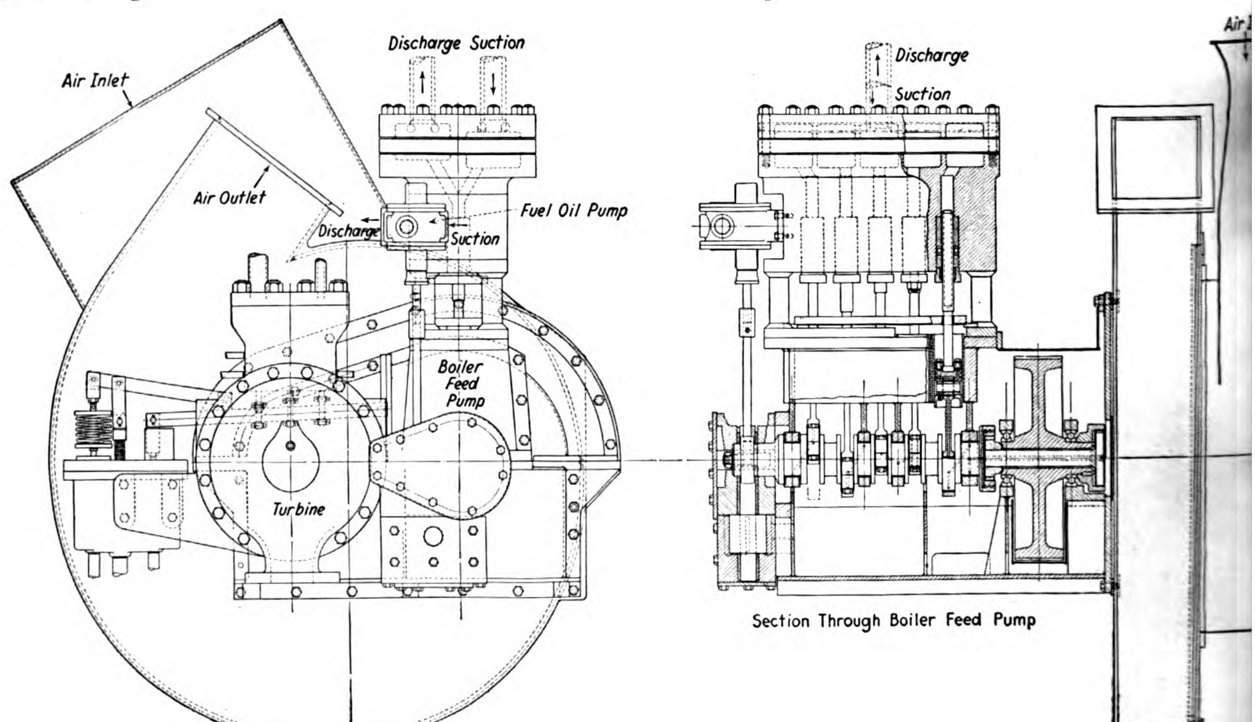


Fig. 3—General arrangement of equipment on the developmental Steamotive unit

general appearance and arrangement of equipment constituting the Steamotive unit in its final condition during the later stages of test at Schenectady and as operating at the Lynn Works of the General Electric Company today is shown in Fig. 3.

From the burner the flame and gases pass horizontally through the completely water-cooled furnace, thence up and back with a 180-deg. turn into the superheater, flowing around the separator, through the economizer and air heater and up the stack. The air for combustion



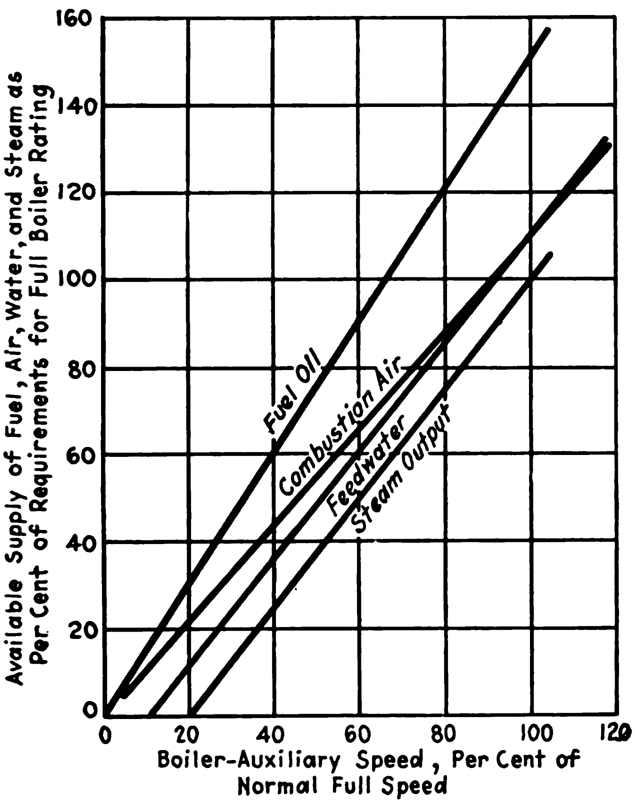


Fig. 4—Available supply of fuel, air, water and steam

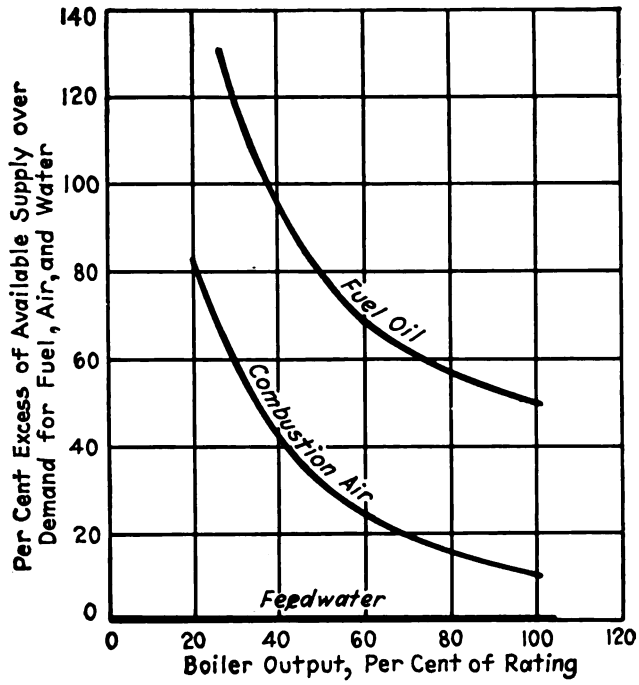


Fig. 5—Excess of available supply of oil, air, and feedwater at various ratings

leaves the blower at relatively high pressure, passing through lanes intersecting the stack and down around the air-heater tubes to the oil burner. There is no induced-draft fan, the blower forcing the air through the burner and furnace under pressure.

The feedwater enters the economizer inlet header, and, after leaving the outlet header, is divided into five circuits, all five of which form the floor, sides, and roof of the furnace as well as the two sets of loops forming the boiler screen. All the steam is generated in these five furnace and boiler circuits and enters the separator with a surplus of about 400 lb. of water per hr. in each circuit. From the separator the dry steam goes through the superheater and directly to the main turbine. The water from the separator is called the "spillover," and it passes through a heat exchanger to the hot well where it mixes with the condensate and is re-fed to the boiler.

Description of Boilers

Burner—The burner is of a special, short-barrel,

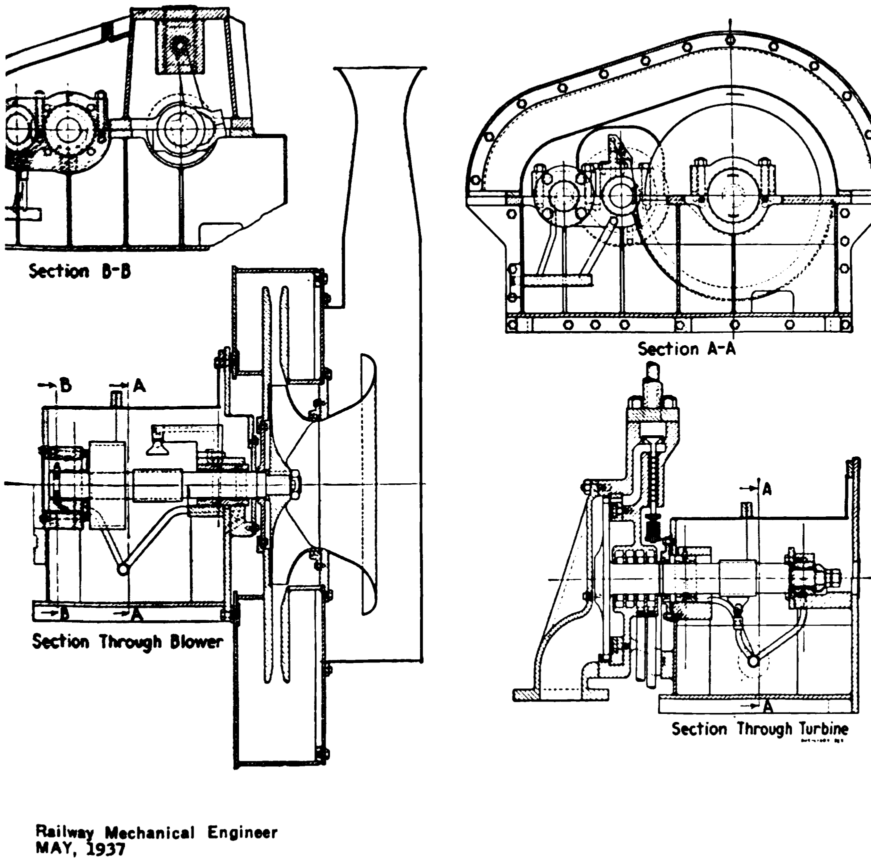


Fig. 6—The auxiliary set which consists of a feed pump, a positive-displacement blower for condensing air, and a fuel pump of the positive-displacement type. These three units are driven by a single variable-speed steam turbine

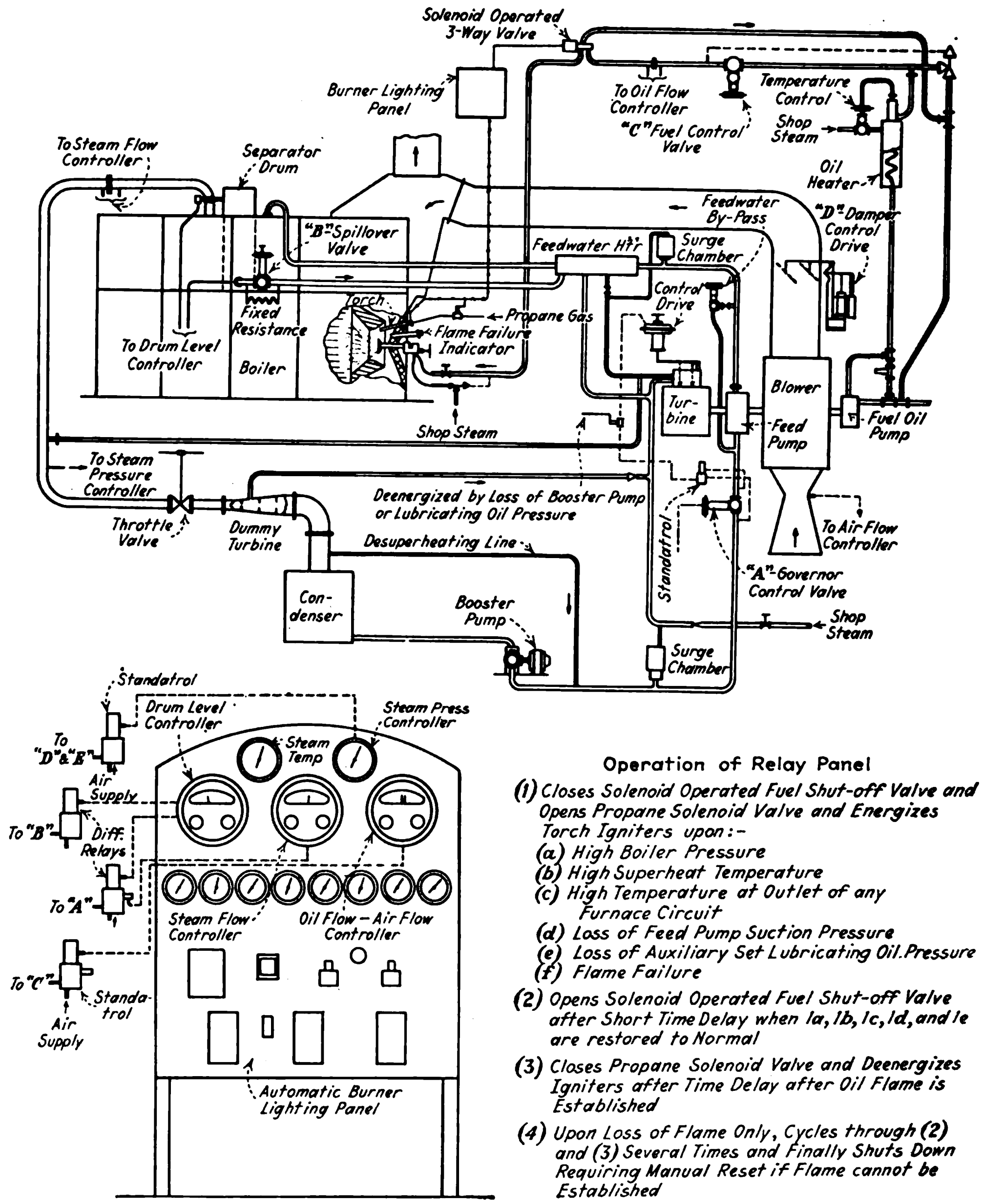


Fig. 7—Diagrammatic layout of the developmental Steamotive unit

steam-atomizing, wide-range design. Guide vanes are provided to secure even distribution of the air to the burner. A pilot gas burner is provided for ignition, and is fed with propane gas stored in portable cylinders. A photoelectric flame-failure indicator is located in the burner box. This cell "sees" the flame through the opening between the burner throat and the impeller plate.

Furnace—The furnace is approximately 3 ft. 6 in. wide and 3 ft. 6 in. high inside the tubes and 7 ft. 6 in. long from the burner wall to the boiler screen tubes. The furnace volume is 90.4 cu. ft. The only refractory in the furnace is in the burner wall. The floor, sides, and roof of the furnace are formed by closely spaced tubes. There are five circuits in parallel in the furnace and boiler screen. The five circuits in the floor, side walls, and roof are connected in such a way as to balance as nearly as possible the heat input to each of the five combined circuits. The length of each floor circuit is 92 ft. 9 in. The average length of each wall circuit is about 183 ft. 6 in., and the average length of each roof circuit is about 49 ft., giving a total average length of each furnace circuit of approximately 325 ft.

Superheater—Due to the removal of excess surface the superheater occupies only about one third of the available space. The roof, rear wall, and side walls of the cavity in the rear of the superheater are lined with closely spaced superheater tubes forming a radiant section, the purpose being primarily to protect the inner casing plates from excessive gas temperature.

The superheater tubes are of KA2S alloy steel (18 per cent chromium, 8 per cent nickel), supported by alloy-steel rods hung from the roof with springs to take up differential expansion. The superheater inlet headers are of seamless carbon steel and the outlet header is of forged KA2S. Except for the inlet and outlet ends of the headers are within the casing and uninsulated.

Economizer—The economizer consists of 29 vertical rows formed by flat coils which give the equivalent of 18 horizontal rows. The coils are hung from the roof by alloy rods in the same way as the superheater. The inlet and outlet headers are inside the casing, and are made from seamless carbon-steel tubes. A tube connects the economizer outlet header to the five furnace floor circuits below the burner. Coiled resistor tubes are connected between the economizer outlet and the floor circuit inlets to introduce a definite pressure drop to in-

sure equal water distribution to each furnace circuit. All tube connections are made by the fusion-welded process and each circuit is continuous without flanged or expanded connections. All tubes are strength-welded to headers and drums. The tubes and separator drum are designed for a factor of safety of five.

Air Heater—The air heater is made up of 1,515 tubes, 2 ft. 4 in. long, and the rows are spaced on 1-in. horizontal and 1 5/16-in. vertical centers staggered. The tube ends are welded into the steel tube sheets. The gas flows inside the tubes and the air cross-flows outside. The air connection at the front of the boiler crosses the gas outlet to the air-heater inlet by means of three streamlined ducts. The contour of the gas outlet corresponds to that of the locomotive roof.

Heating Surface—The boiler heating surface is as follows: Furnace projected surface, 112.3 sq. ft.; boiler-screen convection surface, 115.9 sq. ft.; superheater projector radiant surface, 30.5 sq. ft.; superheater convection surface, 127.8 sq. ft.; and air heater, 578 sq. ft.

Separating Drum—The separating drum is located in the top of the boiler extending through the top casing 13 5/8 in. with the bottom near the furnace roof plate. The drum is supported from structural work in the top

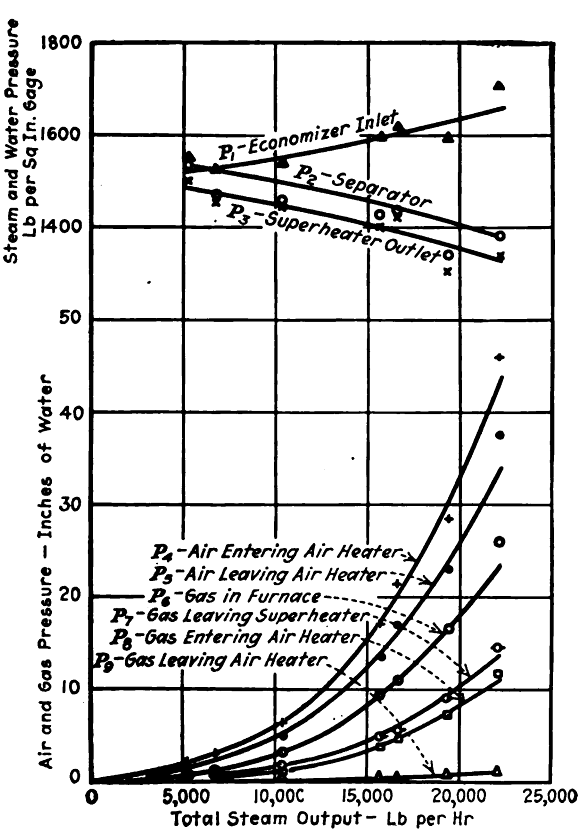


Fig. 8—Performance data showing variation of air, gas, steam and water pressures at various locations in the boiler—Letters refer to pressure-measurement locations shown in Fig. 2

casing. The furnace roof plate is attached to the bottom of the drum as well as the superheater and economizer headers for additional support. The inlet connections from the five furnace circuits enter the drum tangentially, with the ends of the tubes flattened. The two steam-outlet connections are located 180 deg. apart with the center line 18 1/4 in. above the center line of the outlet connections.

Boiler Casing—The casing and structural work was designed for a static pressure of 60 in. of water. It is necessary that the casing remain gas tight against this pressure and it was decided to make the outer casing tight by all-welded construction. The outer casing plates are of carbon steel and the inner plates of heat-resisting alloy. The outer plates also form an integral part of the strength members welded to six vertical I-beam and four angle buckstay columns. The casing and supports were designed for a shock load endways and a side sway or turn-over loading two and one-half times the static load.

Auxiliary Set

In order to save space and complexity of control and improve the efficiency of the boiler auxiliary drive to the highest degree, it was agreed that a combined drive

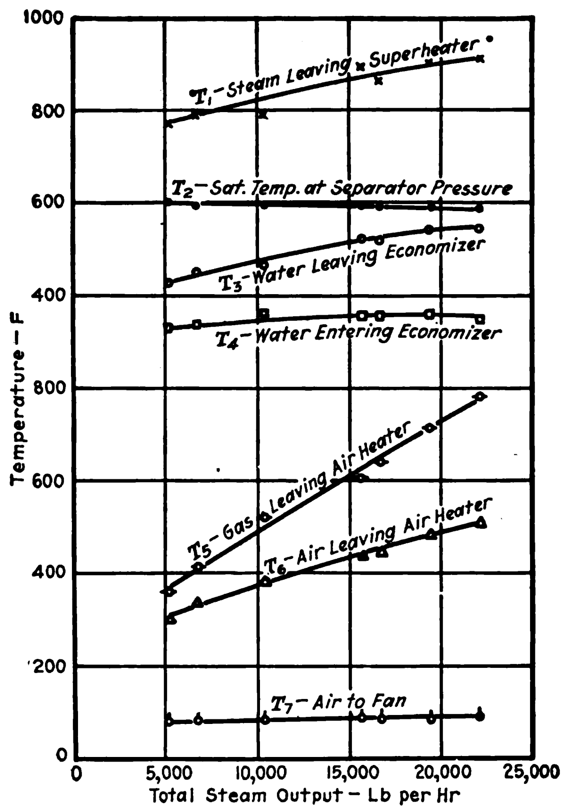


Fig. 9—Performance data showing variation of air, gas, steam and water temperatures at various locations in the boiler—Letters refer to temperature-measurement locations shown in Fig. 2.

for all the boiler auxiliaries would be an essential feature. These auxiliaries consist of a feedwater pump of the positive-displacement type, a blower for furnace combustion air, and a fuel pump of the positive-displacement type. Roughly speaking, the demands for combustion air and fuel oil are proportional to the steam output of the boiler, and in this particular type of boiler the feedwater demand is always in excess of the steam output of the boiler. The characteristics of the various auxiliary requirements are such that the relative speeds of all three auxiliaries should be high for high boiler steam outputs and low for low steam outputs. This makes possible the gearing of the three component parts in a fixed ratio and driving them by a single variable-speed steam turbine. Thus, the entire set runs at a speed determined by the steam output of the boiler with modification to the blower output by means of a damper, and to the fuel-oil output by means of a by-pass on the fuel-oil pump, with the feedwater-pump output as the independent variable from which the speed of the entire set is determined. The relative performances of the three component parts are determined as shown on the

composite curves Figs. 4 and 5. The boiler feed pump is designed to deliver the necessary full-load feedwater flow to the boiler at 100 per cent speed. At this same speed the combustion-air blower is designed to deliver, say, 10 per cent extra air so that it can be controlled by dampering. The fuel-oil pump is given a wide margin of extra capacity in order to take care of possible wear in its parts and also because its power requirements are relatively insignificant, and it is made a final variable dependent upon the air supply. The characteristic requirements of feedwater flow to the boiler due to the constant quantity of spillover water forces the auxiliary to run at somewhat higher speeds at less than full load than would be required by the combustion-air blower, as a consequence of which the combustion-air excess available is always greater at lower loads than at full load.

The particular auxiliary unit which was built for the developmental set is shown in various cross sections in Fig. 6.

The turbine runs at relatively high speed driving a pinion meshing with a high-speed gear on the blower shaft. This same shaft carries the low-speed pinion which meshes with a low-speed gear on the shaft of the boiler feed pump. The fuel-oil pump and the lubricating-oil pump for the set are driven from the outboard end of this same shaft through a pair of spiral gears.

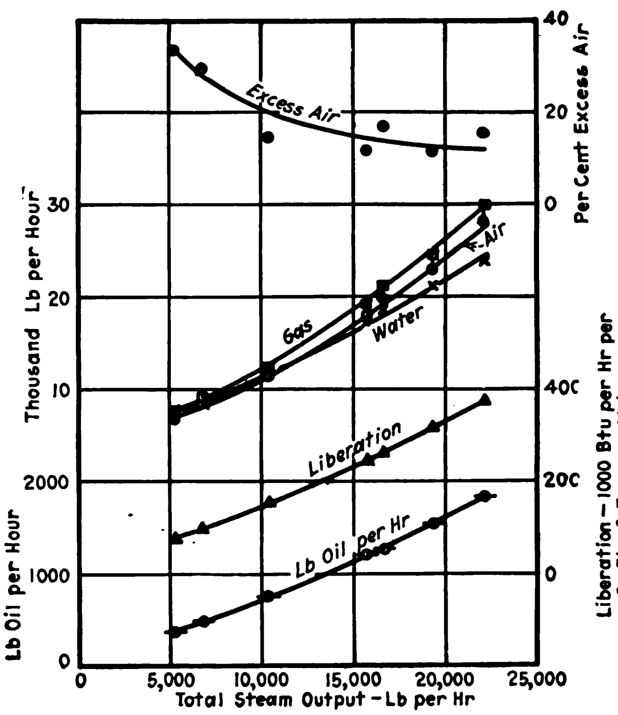


Fig. 10—Performance data from tests of the developmental Steamotive unit

The turbine for the developmental set is a relatively simple machine of only one stage.

The combustion-air blower is a centrifugal compressor having a maximum discharge head of about 60 in. of water. The boiler feed pump is a single-acting five-cylinder piston pump running at a normal full speed of about 800 r.p.m. with pressure lubrication of the crankshaft pins, connecting rods and crosshead wrist pins; relatively speaking, it is of small size and light weight for its capacity and high-pressure service. The pump inlet is supercharged to a pressure of about 75 lb. to avoid any possibility of cavitation due to the rapid motion of the pistons and the valves. The valves themselves are of hardened steel on hardened-steel seats of approximately 1 in. diameter and have a lift of from 0.03 to 0.05 in. With such small valves it is essential that no dirt particles of any size be allowed to enter the pump and a fine-mesh strainer is provided at the pump inlet. Fig. 3 shows the unit as it was finally assembled, illustrating relative proportions and compactness of the design.

Automatic Control

The automatic-control equipment is shown diagrammatically in Fig. 7.

In view of the limited amount of water and heat storage in Steamotive units and since all natural circulation is eliminated, it is of utmost importance in operating

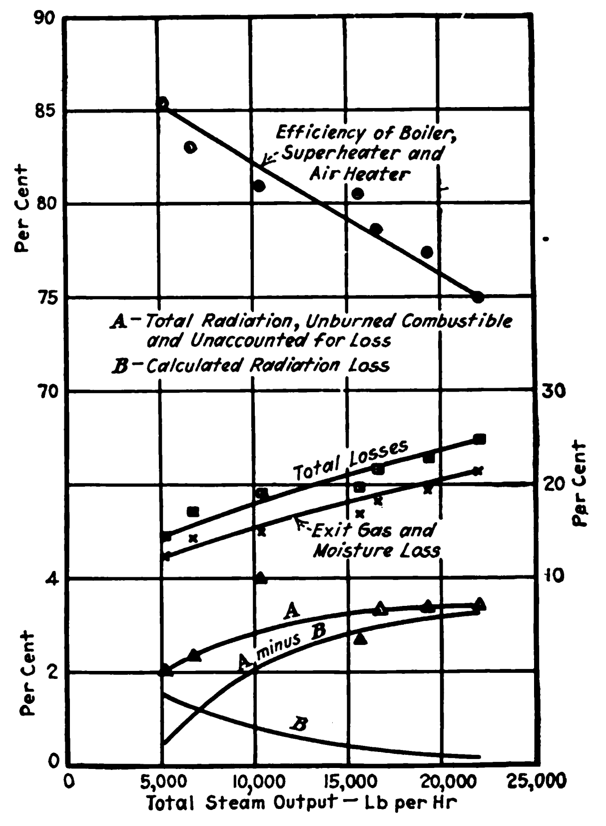


Fig. 11—Performance data from tests of the developmental Steamotive unit

this unit that water be fed as nearly as possible equal to the rate of steam output plus spillover. To accomplish this purpose the speed of the auxiliary set is governed to maintain any desired water flow from the feed pump.

The desired rate of water flow is established by measured indications of total boiler steam flow and separater-drum level, and the variable water-flow governor regulates the speed of the turbine driving the auxiliary set to maintain this water flow regardless of variations in steam or water pressure, feed-pump efficiency, or other variables.

One of the important principles upon which the Steamotive unit is designed is that of maintaining an excess of water leaving the evaporating furnace circuits. The quantity of this spillover water delivered into the separating drum is maintained constant at all outputs. The excess water flow is secured by means of a fixed-resistance tube connected to the bottom of the separating drum which will discharge the desired quantity of water with a given difference between drum and back pressures. A constant water level in the separating drum is maintained by the automatic control which adjusts feed-pump delivery, which is greater than steam output by the amount of spillover.

The fixed-resistance tube for normal spillover is in

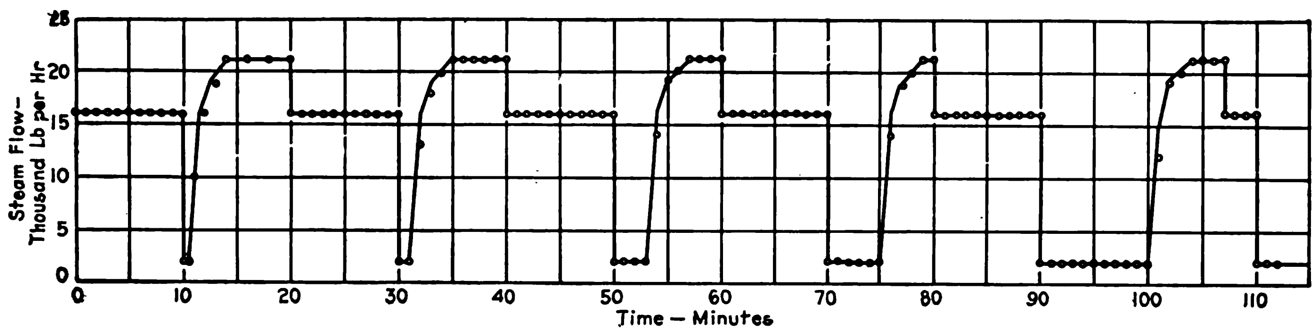


Fig. 12—Power-demand curves—The curve indicates the desired load cycle and the plotted points show the actual ratings reached by the boiler

parallel with the automatic spillover valve which opens when the water level exceeds the normal limit, quickly bringing the level back to normal by means of the large increase in spillover.

The auxiliary set is designed to provide an excess of air and oil at any given feed-pump speed and the automatic-control equipment is arranged so that necessary throttling of both is provided to maintain a constant steam pressure at the boiler outlet. In addition, the ratio of fuel and air is closely controlled in accordance with metered indications of each so as to maintain the minimum allowable excess air for good combustion.

The burner is provided with a propane torch with dual spark ignition and with a photoelectric flame indicator. A three-way valve is located in the oil line to the burner to shut off automatically the fuel-oil supply to the burner and recirculate the oil to the suction side of the oil

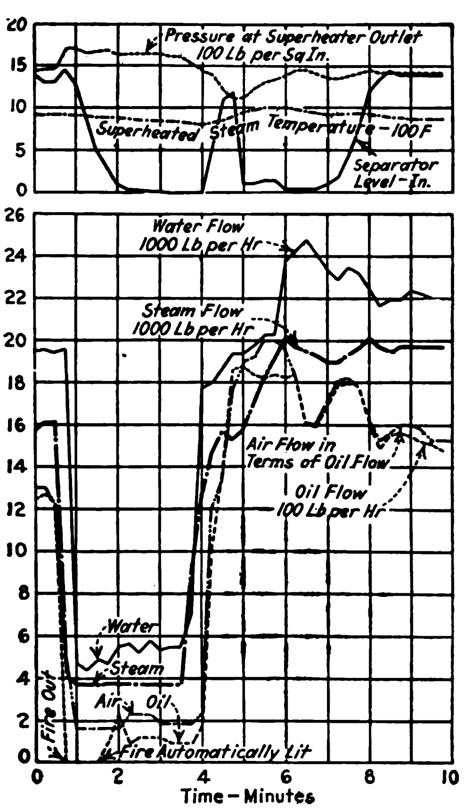


Fig. 13—Data from load-swing test of the Steamotive unit

pump. This three-way valve, the solenoid valve in the propane line to the torch, and the spark igniters for the torch are interlocked to perform the following functions: (1) Upon closure of the lighting switch, the igniters are energized and the propane valve opens, lighting the torch. After a short delay, the fuel-oil control valve is opened to the burner, and as soon as ignition of the oil fire is established, as indicated by the photoelectric flame detector, the propane torch and igniters are cut off after a short time delay. (2) The fuel oil is shut off in case of (a) high boiler pressure, (b) high superheat temperature, (c) high temperature at outlet of any furnace cir-

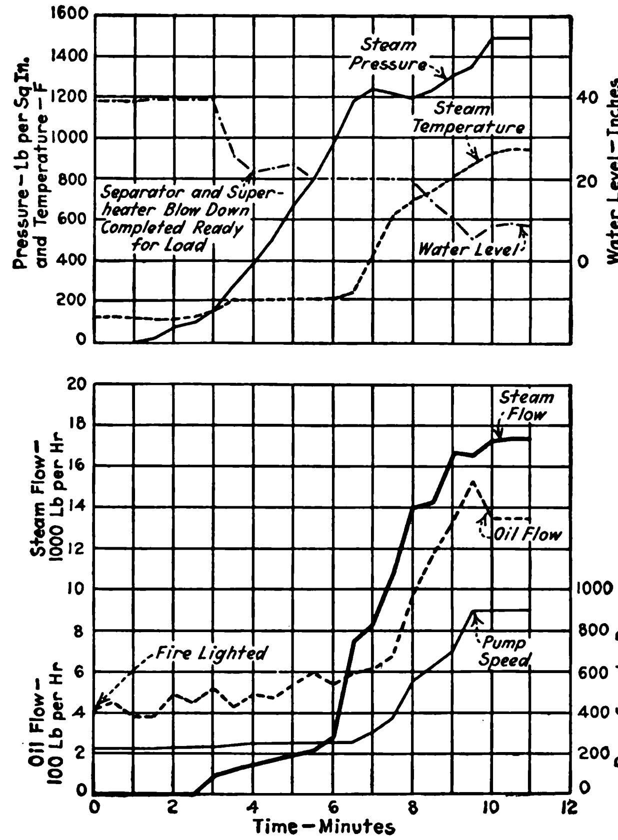


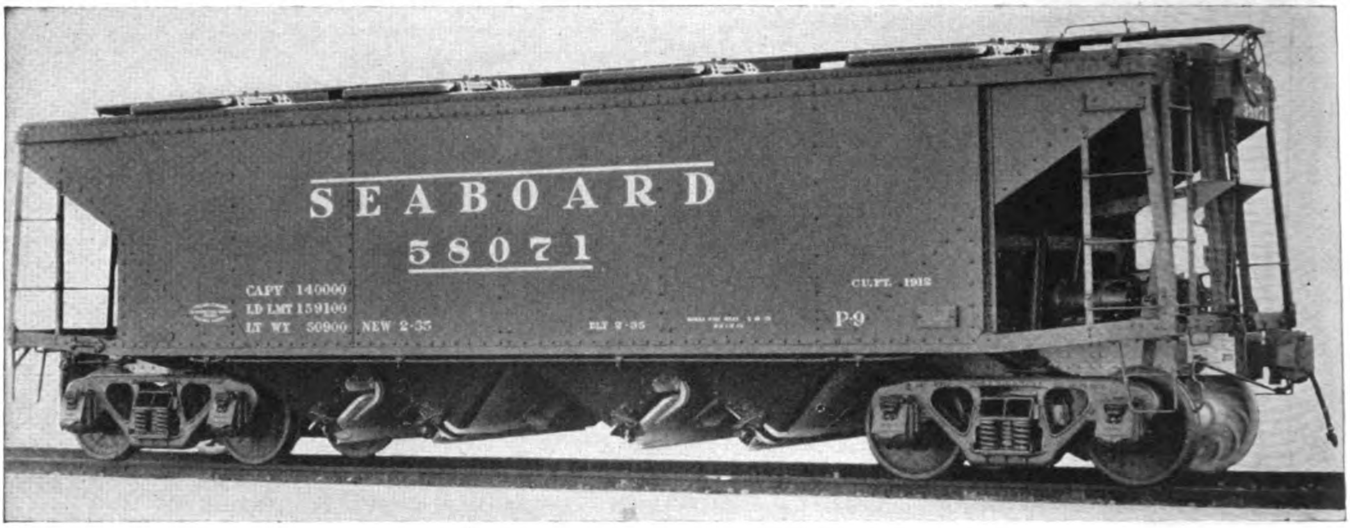
Fig. 14—Data from cold-starting test of the Steamotive unit. The unit had been shut down for 16 hrs. prior to lighting the fire for this test

cuit, or (d) flame failure. (3) The oil burner is automatically relighted when 2a, 2b, and 2c are restored to normal. (4) Upon loss of flame only, the relighting cycle is repeated several times, and if flame cannot be established, the unit is shut down, requiring manual reset. (5) Upon loss of feed-pump suction pressure or loss of lubrication-oil pressure for the auxiliary set, the oil fire and torch are cut off and the air supply to the governor of the auxiliary-set turbine is likewise cut off, shutting down the auxiliary set.

Test Results

Operating and heat-balance data obtained from final tests are given in Figs. 8, 9, 10, and 11. Before the tests

(*Continued on page 213*)



Seaboard covered hopper car for phosphate service

Seaboard Builds 70-Ton

Hopper Cars for Phosphate

Cars with average light weight of 50,800 lb. designed for shipping extremely fine material with minimum loss due to leakage as well as rapid unloading at destination

A 70-TON hopper car to meet the requirements of phosphate rock loadings at several mines on its southwest Florida lines was designed late in 1934 by the mechanical department of the Seaboard Air Line. Early in 1935 100 cars of this design, which has four hoppers and a roof with water-tight hatches, were built by the Pullman-Standard Car Manufacturing Company at its Birmingham, Ala., plant, and a year later an additional 100 cars of this design were received from the same plant.

The phosphate mining operation is largely hydraulic and, for many years, the washings from the larger or pebble phosphate were discarded. A flotation process of recovery for this very fine material was developed and it became necessary to have cars of a type and tightness to handle dry, in carload lots, this material which is approximately as fine as granulated sugar and has practically no bind or pack. Even the smallest openings, which would cause no loss with pebble phosphate, will cause the fine phosphate to leak and make cars unsuitable for service. Rapid gravity unloading through the bottom doors was also essential.

The following are some of the general features of these latest types of cars:

Length inside, ft. and in.	34— 9¾
Length over striking castings, ft. and in.	36— 6
Truck centers, ft. and in.	26— 6
Width inside, ft. and in.	10— 2
Height at eaves, ft. and in.	9—11⅞
Height over running board, ft. and in.	10— 9¾
Capacity level full at eaves, cu. ft.	1,912
Average light weight, lb.	50,800

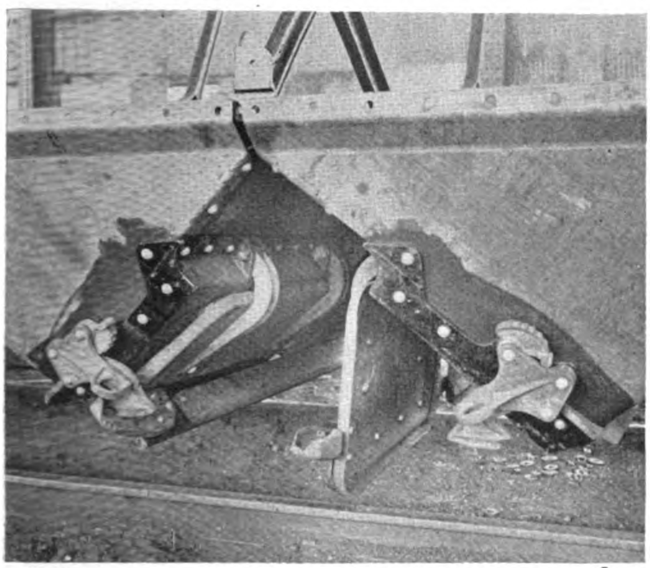
The body of these cars is of as simple structural design as possible to meet the requirements. Consideration was given to the accuracy with which they could be built, and the ease with which they could be repaired. The floors and cross ridge sheets have slope angles of 40 deg. The hopper construction is such that there are no valleys where this angle of slope is reduced, or where the material is required to change the direction of flow in discharging. The interior bracing is of cast-steel truss formation, thus permitting of longitudinal or cross flow through this bracing to equalize loading or unloading movement of the material. The fit of the doors on the door frames is such that a very tight closure is assured, and will be maintained over a long period by the manner in which this fit is accomplished. Rapid loading and unloading, tightness of doors against loss of lading, and water tightness of the roof and car sides were the primary requirements of the body design.

The body material was largely open-hearth plates and rolled shapes. The center sills are 12-in. 30.9-lb. ship channels with 7/16-in. by 13-in. continuous cover plate, and riveted and welded reinforcements along the lower flange, so that the eccentricity of the draft center line to neutral axis of sills is practically zero. This type of construction was used to afford the widest door openings and least obstruction to flow in unloading. The side sills, end sills, top side plates, corner and end posts, and

Roof construction of the Seaboard 70-ton hopper car

stakes are all rolled sections. The car sides are 3/16-in. open hearth steel; the floors, outside and inside hopper sheets and cross-ridge sheets are 1/4-in. open-hearth steel. The longitudinal hood is 3/16 in. Cor-Ten steel. The interior bracing is Unitcast steel crossbearer arms and framing between the side sills, stakes and center sills at three places. The hopper door construction is Wine hopper frames with 3/16-in. Cor-Ten steel doors secured with Wine door locks. The body bolster construction is Unitcast W-type one-piece cast-steel bolsters.

The roofs of these cars are 1/8-in. Cor-Ten steel. All seams are riveted with tarred felt between sheets. The roofs are fitted with eight roof hatches. The hatch openings are reinforced with a channel frame. The roof doors, or hatch covers, are 1/8-in. Cor-Ten steel hinged transversely so that they will lie approximately flat on the roof when open and give maximum clearance for loading under the storage bins. The hatch covers are secured by a sliding bolt type of lock. The running boards are wood and fitted with shields at the hatch



The hoppers are equipped with Wine door frames and pressed Cor-Ten doors

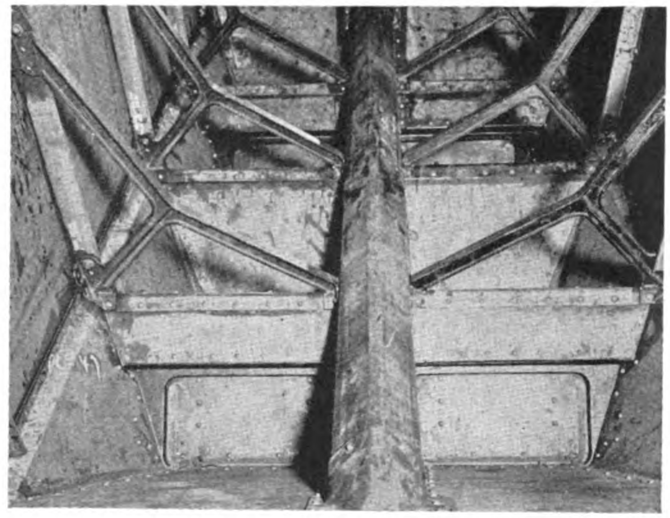
openings to prevent materials in the loading of cars from lodging under these running boards. The roofs must test for water tightness with spray or hose test.

The truck side frames are the American Steel Foundries Vulcan type for 6-in. by 11-in. journals. This type of truck was selected on account of the limited facilities at the mines for changing wheels if found necessary. The journal boxes are Symington malleable iron for Vulcan trucks. The wheels are 850-lb. chilled-iron single-plate, A.A.R. Standard. The springs are A.A.R. with one Cardwell friction unit Type A at each spring group. Truck bolsters are cast steel. Truck brake rigging, beams, brake shoes, hangers and other parts conform to A.A.R. or railroad specification.

Several types of draft gears were used in these cars, the division being between Cardwell, Cardwell-Westinghouse, Waugh, and National. Couplers are A.A.R. Type E, 6 1/4-in. by 8 in. shank, bottom operated. Yokes are A.A.R. vertical cast steel.

The air brakes are Westinghouse Type AB, and hand brakes are divided between Universal and Ajax. Metal brake steps of the T-Z design are used.

No attempt was made to lighten the design of the car at the sacrifice of useful material, or by using any details not entirely suitable for the service requirements. The satisfactory light weight was accomplished by careful



Interior of the car showing the bracing

consideration of the different elements wherein weight might be saved with no loss of safety or service value. The car, with its roof, has a ratio of pay load to gross load of 75.8 per cent.

Automatic Heating System For Refrigerator Cars

A closed heating system has been designed by the Safety Car Heating & Lighting Company for application to refrigerator cars with ice bunkers and Silica Gel iceless refrigerator cars. The heating system circulates diethylene glycol and is operated automatically through thermostatic control of a heating element which burns liquefied propane gas. In well-insulated cars the thermostatic control regulates the system to maintain set inside car temperatures with maximum fluctuations of about 3 deg. F. above and below the set temperature. Tests have shown that temperatures within the car remain within this limit of 3 deg. F. and that the maximum variation in temperature between the top and bottom of the car does not exceed 3 deg. F. The results of a test run between Summer, Wash., and Jersey City, N. J.,

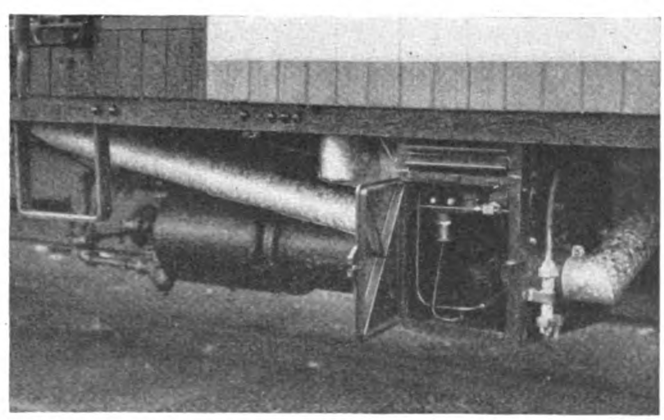


Fig. 2—Safety heating system installed on a Merchants Despatch refrigerator car

during which the outside temperature varied from 12 deg. F. below zero to 62 deg. F. above zero, showed that the heating system kept the average inside temperature at 36 deg. F., and that the maximum variation in temperature between the top and the bottom of the car

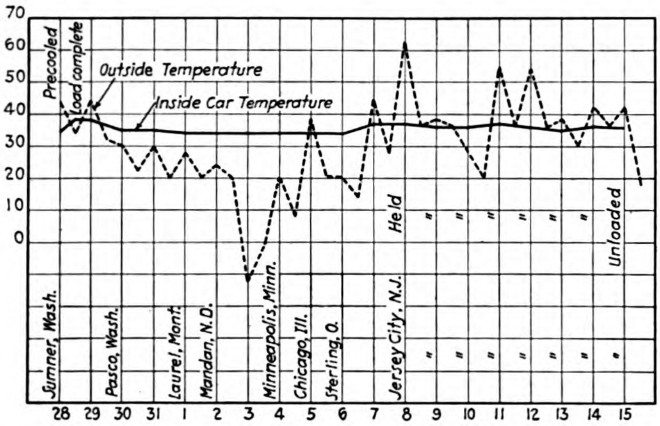


Fig. 1—Record of inside and outside car temperatures of a shipment of hot-house rhubarb moving under heater service from Sumner, Wash., to Jersey City, N. J. The thermostat setting was 36 deg. F., and the average temperature maintained was 36 deg. F.

was 3 deg. F. The results of this test are plotted graphically in Fig. 1.

A box containing the heater and its controls is placed outside the car beneath the floor, and the heated diethylene glycol passes from the heater to pipes placed on the car floor under the floor racks. A thermostat bulb placed inside the car operates the controls of the heating element and keeps the burner in operation the proper length of time to maintain the desired temperature. It has been found that well insulated cars can be preheated in less than 24 hr. to a temperature of 40 deg. F. when the outside temperature is 40 deg. F. below zero. The liquefied propane gas is stored beneath the car floor in a tank which in most installations has a capacity of 300 lb.

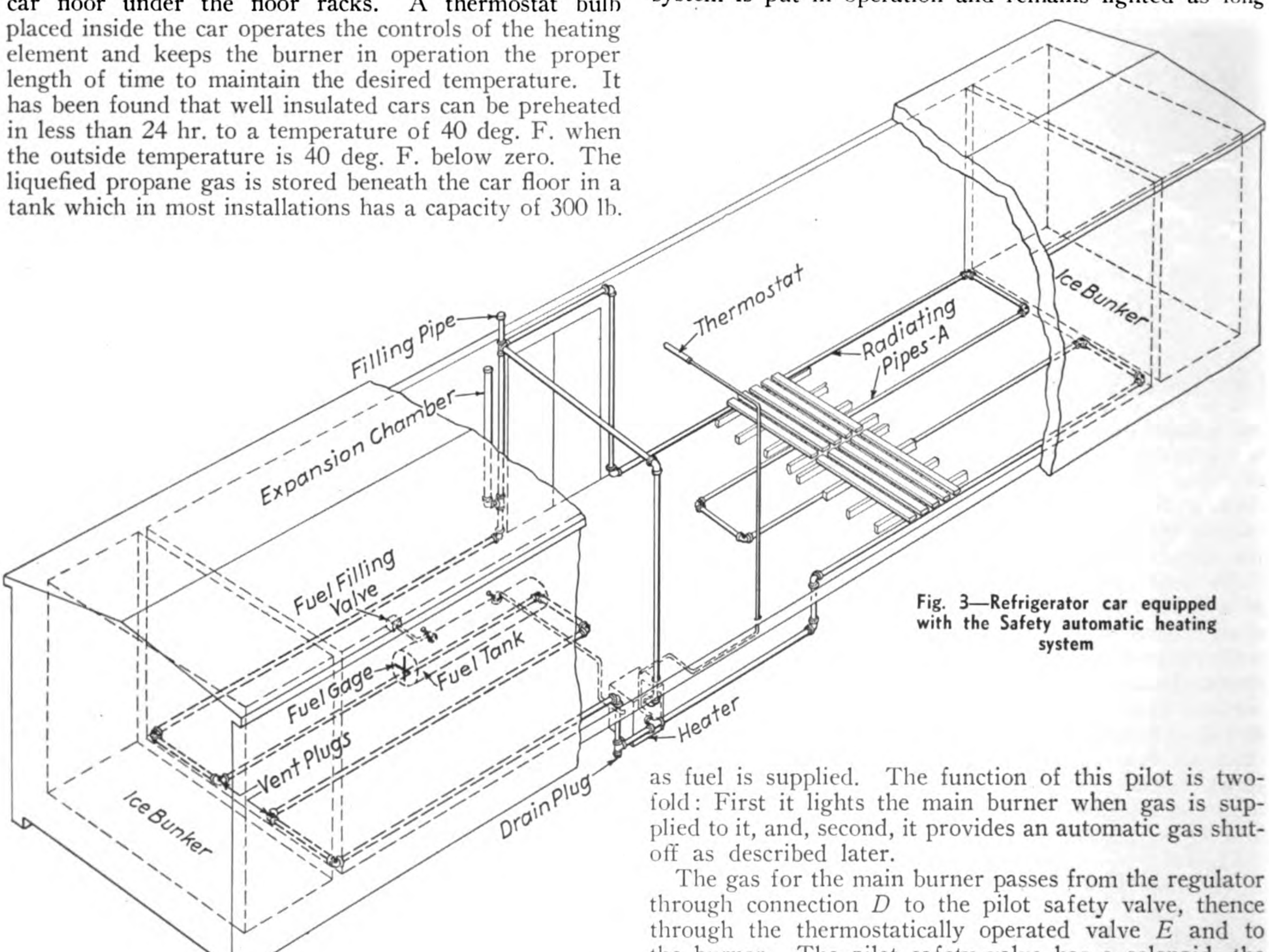


Fig. 3—Refrigerator car equipped with the Safety automatic heating system

Diagrams of the system, heating element and controls, and an illustration of an application of the heating element to a Merchants Despatch refrigerator car are shown in the various illustrations. A detailed description of the heating system follows:

The heat is applied to the car by means of radiation from pipe coils *A* located on the floor under the floor racks shown in Fig. 3. The ends of these coils connect, as shown in Fig. 4, to a heating element *B* in the heater assembly forming a closed system which is filled with a solution of diethylene glycol. As heat is applied to the heater element, heating of the solution causes it to circulate in the same manner as in the usual hot-water heating system. The solution lasts indefinitely and new solution is required only to replace any loss due to leakage.

Propane, a liquefied petroleum gas, is used to furnish the heat and is carried in a tank suspended under the car body. This tank has a gage, which indicates the amount of fuel in the tank, and necessary filling and shut-off valves.

Vaporized propane is taken from the top of the tank and piped to the heater at *C* where it enters the liquid trap. This trap serves to retain liquid propane which may find its way to that point and prevent it from entering the pressure regulator. The vapor up to this point is under pressure corresponding to the atmospheric temperature. The pressure regulator reduces this pressure to 13 in. of water and holds it constant at that value for supplying the burner.

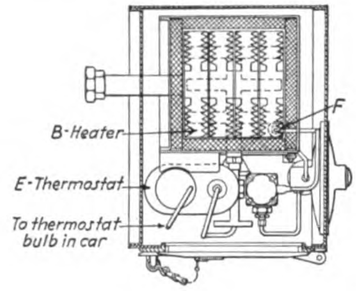
A small amount of the low-pressure vapor is fed directly to a small pilot burner which is lighted when the system is put in operation and remains lighted as long as fuel is supplied. The function of this pilot is twofold: First it lights the main burner when gas is supplied to it, and, second, it provides an automatic gas shutoff as described later.

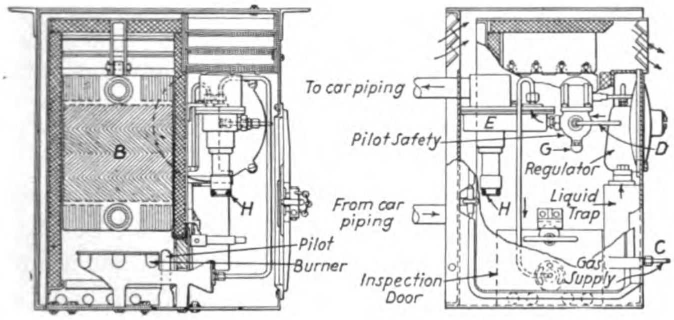
The gas for the main burner passes from the regulator through connection *D* to the pilot safety valve, thence through the thermostatically operated valve *E* and to the burner. The pilot safety valve has a solenoid, the winding of which terminates in a thermocouple so located at *F* as to be heated by the pilot flame. The thermo-electric current thus generated energizes the solenoid, which acts on an armature attached to the valve, to hold the valve in an open position. If the pilot be extinguished from any cause, the cooling of the thermocouple will de-energize the solenoid and permit a light spring to close

the valve, thus shutting off the supply of gas to the main burner. The pilot valve must be manually reset after relighting the pilot by removing cap *G* and lifting pin which opens the valve and brings the armature in contact with the solenoid core.

The supply of gas to the burner is controlled by the thermostatic valve *E* which is composed of a snap-action valve actuated by the expansion and contraction of a metal bellows connected by means of a small-bore tube

Fig. 4—Heater and controls for Safety automatic heating system





to a bulb located within the car body and filled with a temperature-responsive vapor. As the car temperature rises or falls the change in pressure within the bellows operates to close or open the valve as required to maintain a constant temperature in the car. The knurled cap *H* moves over a scale divided in degrees *F* and, to adjust the system for any desired car temperature, it is only necessary to turn *H* to the desired temperature on its scale.

The heating element consists of an assembly of cast sections similar to the usual hot-water radiator, and has ribbed external surfaces for increased heat transfer. These are enclosed in an insulated casing with openings at the bottom to admit necessary air for combustion and at the top for escape of the products of combustion.

The fuel supply may be carried in a tank permanently attached to the car and refilled from storage tanks established at convenient points, or the car may be equipped with suitable racks for receiving the standard flasks in which propane is shipped, the procedure in this case being to remove flasks as they become empty and replace with full ones.

Turbo-Electric Locomotive

(*Continued from page 209*)

were begun there was some apprehension about being able to reach the desired capacity of 21,000 lb. of steam per hr. with any reasonable combustion efficiency. Although the design capacity for continuous running was for 16,000 lb. of steam per hr., the unit ran 40 continuous hours at 21,000 lb. per hr. and was tested up to 22,000 lb. per hr., which was the limit of the blower for continuous operation.

At the normal load rate of 16,000 lb. of steam per hr. the feedwater pressure entering the economizer is 1,610 lb. and the steam pressure at the superheater outlet is 1,390 lb. there being a 220-lb. pressure drop through the economizer, boiler, and superheater. The steam temperature leaving the superheater at an output of 16,000 lb. per hr. is 870 deg. F., rising to 910 F. at 22,000 lb. per hr. and dropping to 770 deg. F. at 5,000 lb. per hr.

The air pressure entering the air heater is 18 in. of water at a steaming rate of 16,000 lb. per hr., which increases to 43 in. at a rate of 22,000 lb. per hr. The air entering the burner is 45 deg. F. at a rate of 16,000 lb. per hr. and 500 deg. F. at a rate of 22,000 lb. per hr. Combustion is complete within this range of output with less than 15 per cent excess air, and combustion rates from 25,000 to 375,000 B.t.u. per cu. ft. of furnace volume per hr.

The boiler efficiency varies from 75 per cent based on the high heat value at a rate of 22,000 lb. per hr. up to 85.5 per cent at a rate of 5,000 per hr. These efficiencies are 4 to 5 per cent higher than those originally anticipated from the limited heating surface permitted under the conditions to be met in locomotive design.

Fig. 12 shows the type of load-cycle tests which were made on the unit to determine its suitability for performance on a high-speed locomotive. The solid curve indicates the desired load cycle and the plotted points show the actual ratings reached by the boiler at each particular time.

The load-cycle tests on the unit were in two periods of 80 and 267 hr. duration. Approximately 450 cycles from minimum to maximum load were made. The total operating time of the unit at Schenectady was 950 hr.

Fig. 13 shows results of a typical test made to determine the flexibility of this unit. This simulates a station stop of a locomotive, when the steam flow, except for driving the auxiliary set, is quickly shut off. The unit continues at a low load for 3 min. when the throttle is opened, increasing the steam flow to approximately 16,000 lb. per hr. in 1 min. and to 20,000 lb. per hr. in 2½ min. The effect of these load changes upon steam pressure, steam temperature, water level in the separating drum, water flow, air flow, and oil flow are clearly shown.

During these load-cycle tests, such as shown in Fig. 11, oil was burned at rates well above the maximum output rate for short periods during the load pickup, and during some of these periods the liberation was as high as 500,000 B.t.u. per cu. ft. of furnace volume per hr. with low excess air, complete combustion, and freedom from smoke.

Fig. 14 shows how quickly the boiler may be placed in service from a completely cold condition, except that the auxiliary set was driven from an external source. Note that the boiler is steaming at reduced pressure within 4 min. and has picked up to full load with normal pressure and temperature after 6 min. more.

Wine Trains.—Instead of snow trains or bicycle trains as we operate them over here, the French railways operate wine trains from Paris to the various wine growing centers, so that the connoisseurs may sample the delights of the vintage of the grape at the famous places where it is grown and pressed.

The Pay Gets Through.—During the recent flood, the general office building of the Louisville & Nashville was partly under water, but the employees got their pay just the same. Hiring a boat, the paymaster rode down the flooded streets and into the building, and, pulling on his oars, rowed up to the vault, opened it, and rowed inside to get the money with which to meet the payroll.

Axles and Bearings Tested in

Timken Research Laboratory

Equipment installed by Timken Roller Bearing Company used for fatigue testing of full-size locomotive axles and bearings. Torque device records power loss in bearings

LATE in 1936 the Timken Roller Bearing Company, Canton, Ohio, installed in its research and testing laboratory a testing machine capable of determining the fatigue strength of full-size locomotive-axle assemblies 8 ft. long and up to 14 in. in diameter. This machine, designed by Timken engineers as a means for obtaining basic data on full-size axles operating at high speeds and equipped with Timken roller bearings, can be used for testing two axles simultaneously, one axle being mounted on each end of the machine as shown in one of the illustrations. A cantilever loading system is used, the load being applied by springs capable of 80,000 lb. load. Standard Timken locomotive driving-wheel journal boxes are used on the load end of the shaft, while the wheel end is mounted in a central shaft. This shaft is equipped with Timken rolling-mill type bearings. The main shaft is driven through an eight-strand V-belt by a 100-hp. variable-speed motor, the main shaft being designed to run at a maximum speed of 1,100 r.p.m.

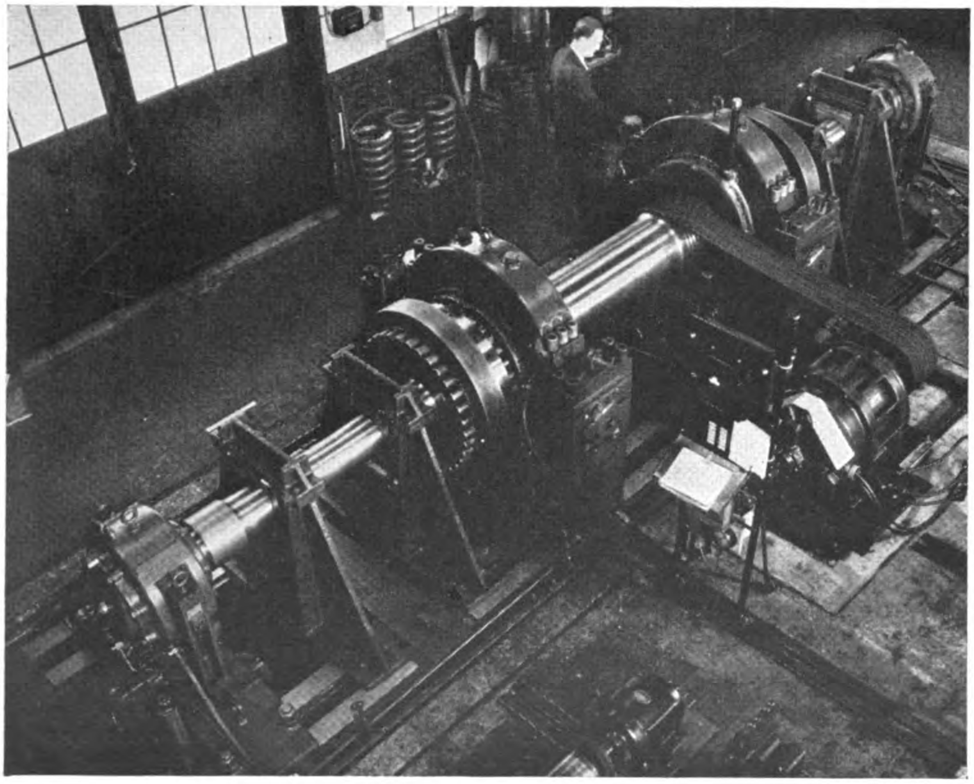
Axle fatigue failure develops within the wheel fit just inside the inner wheel-hub face. The general nature and the location of the axle failure produced by the Timken axle testing machine is comparable to that produced under actual service conditions.

The axle testing machine is one of the additional pieces of equipment recently installed in the new laboratory. A large and complete set-up for photoelastic research and testing also has been installed. Much valuable data as to stresses and their distribution in various design members such as fillets, notches and other design shapes for which there is no analytical solution for the calculation of stresses have already been secured on this equipment. A typical fringe pattern showing the lower stress concentration in an axle due to the relief groove in the hub pressed on the axle is shown in one of the illustrations.

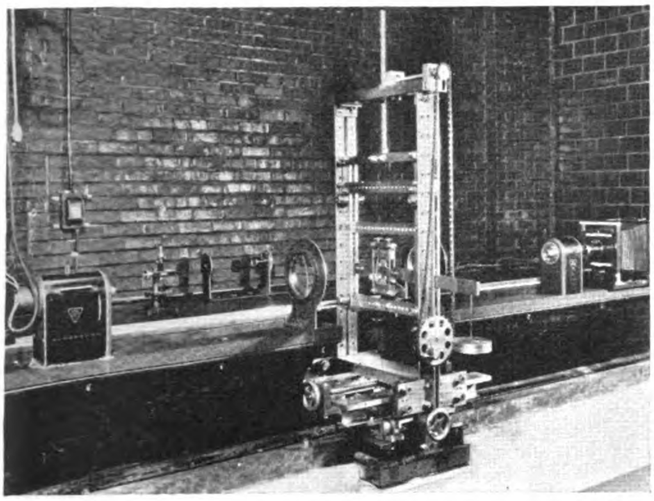
Office, darkroom and drafting facilities as well as sufficient machine-tool equipment are provided in the laboratory, which is operated in a 24-hr. basis, most tests being continued to destruction. Chemical and metallurgical facilities are available in the Steel and Tube Division laboratories of this company, which are used to supplement and amplify the work done in the physical testing laboratory. Much of the machine work in preparing specimens is done in the bearing-plant tool room or experimental department, thus saving laboratory time and floor space.

One end of the building is occupied by a battery of eight machines designed to test bearings up to 8 in. outside diameter to destruction under radial and thrust load. These machines consist of test spindles on which are mounted four bearings. Two spindles are connected by a coupling and driven through spiral gears from a motor shaft, each shaft driving up to four sets of spindles. By changing the spiral driving gears a wide range of speed may be secured.

Bearings are loaded in these machines by a hydraulic



Machine for making fatigue tests on full-size locomotive axles up to 14 in. diameter

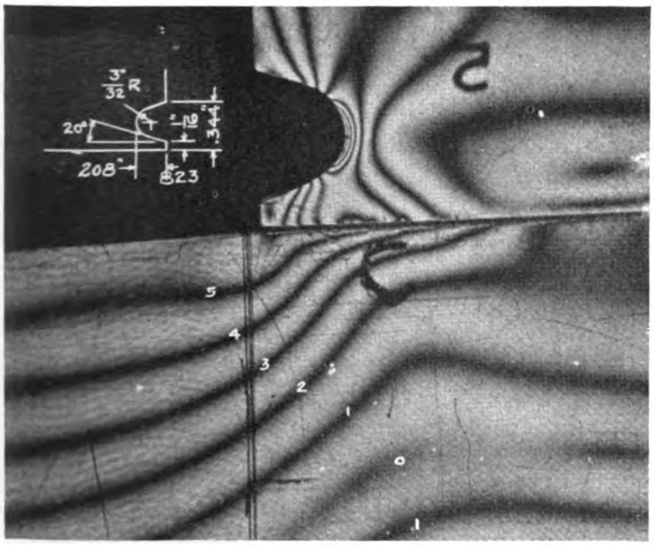


Photoelastic records of stress distribution are made on this equipment

pressure system, oil being supplied at 1,800 lb. per. sq. in. to the control system and each spindle being equipped with an adjustable relief valve. Through these valves the oil is fed to cylinders, one being located below each spindle. The cylinders and the pistons both float, transmitting the load through bell cranks on a fixed mounting to a yoke connected to the center bearings on the spindle. The load is then transmitted to the bearings at each end of the spindle. By this arrangement all bearings receive the same load. Thrust load is applied through a lever system compensated by knife-edge levers to obtain concentric loads. In the case of small bearings the thrust load is applied by dead weighted levers, while on the larger bearings it is applied by hydraulic pressure.

Testing Machine for 24-in. Bearings

One of the most recent installations in this laboratory is a bearing testing machine which is thought to be the largest in the world. This was designed by Timken engineers to meet their special needs. In it single- or double-row bearings up to 24 in. outside diameter can be tested for fatigue under both radial and thrust load. Radial loads up to 500,000 lb. and thrust loads up to 200,000 lb. may be applied to the bearings under test by means of hydraulic rams. A torque device, installed between the transmission and the test spindle, indicates the power loss in driving the bearings.



Typical example of fringe pattern showing stress concentration in an axle

Supplementing the 24-in. radial thrust machine is a 12-in. unit which has a capacity of 150,000 lb. radial and thrust load. This unit measures torque through a cradle on which both the driving motor and transmission are mounted. The lubricant is circulated through a cooling system beneath the machine.

Two profilographs are installed in an air-conditioned room. The unit shown in one illustration is capable of 5,000 times vertical magnification, while the other is used for amplications up to 2,000 times. This equipment was originally developed for the Timken company in the research laboratories of the University of Michigan and is used for checking surface finish. A beam of light from a 108-watt projection lamp passes through a slit and lens to a small mirror mounted at an angle on one end of a bell-crank lever, the other end of the lever carrying a diamond point which rests on the specimen. This specimen is mounted on a platform having rectilinear motion, this platform being connected through gearing to the recording drum. From the small mirror the beam of light is reflected to a series of three other mirrors to increase the length of the light path, the beam being finally collected in a cylindrical lens and focused to a pin point on a sheet of sensitized paper mounted on the drum shown at the back of the panel.

To check the quietness of bearings, a machine was developed which allows a bearing to be loaded with any pressure desired up to 1,000 lb. and run in a soundproofed room for testing. The machine is capable of running at constant speeds or being accelerated or decelerated as desired.

Pullman Remodels Sleeping-Car Facilities

Three new and radically different accommodations, all of the private room character, recently announced by the Pullman Company, will be found in the equipment now being built for the North Western-Union Pacific-Southern Pacific Streamliners "City of San Francisco" and "City of Los Angeles," the Santa Fe's "Chief," the New York Central's "Twentieth Century Limited" and the Pennsylvania's "Broadway Limited."

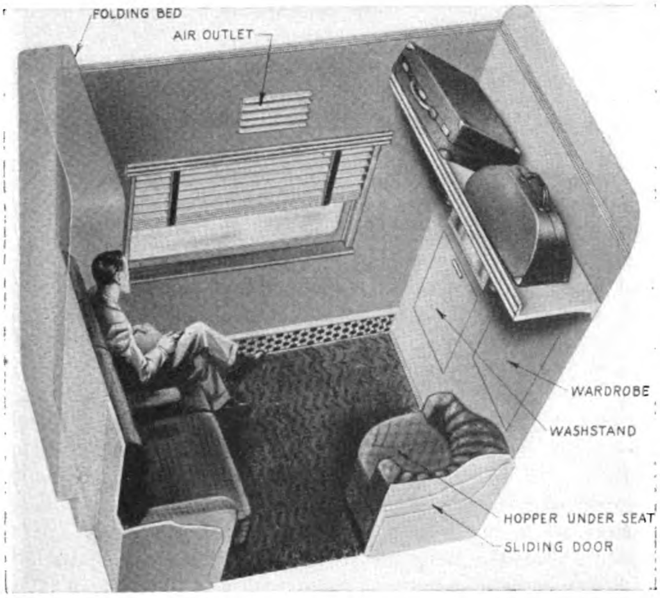
Two of these accommodations will bear the drawing room and compartment designation familiar to Pullman patrons, but important changes in arrangement have been devised for the new-type rooms. The third accommodation, called the roomette, is new from top to bottom, including the name.

The "Roomette"

The roomette is a small, completely enclosed, private room within the space of a section, containing one bed. Eighteen roomettes can be placed in one Pullman car. In daytime the bed folds into the wall at one end of the room, and the passenger has a sofa seat of the latest and most comfortable contour, with ample space for lounging, or for undressing before the bed is lowered for the night-time arrangement. For dressing the passenger can make the whole room space and its complete toilet facilities available by returning the bed to its niche in the wall. The slightest effort will accomplish this, and a safety ratchet eliminates any danger of the bed falling during the operation. When the bed is made down for the night it is fastened at the foot by an automatic lock. This is easily released when the passenger desires to

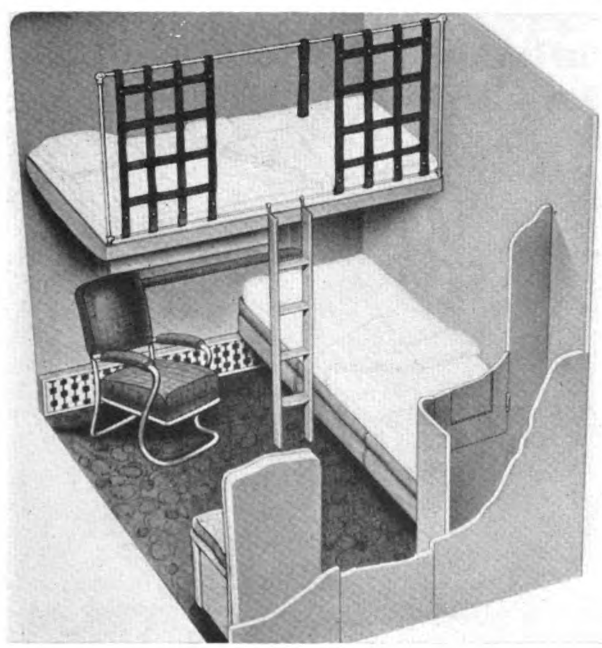
raise the bed, and the lock then reverses and holds the bedding in place. The bed is 6 ft. 5 in. in length.

The door of the roomette can be locked at night, or left open and a curtain drawn across the opening. The patron has many conveniences, such as individual regu-



The arrangement of facilities in the Pullman roomette

lation of ventilation, heat and light; complete toilet facilities, with washstand folding into one wall, and above it a mirrored cabinet for toilet articles, with tubular lights on each side; a locker in which to hang clothes; a large



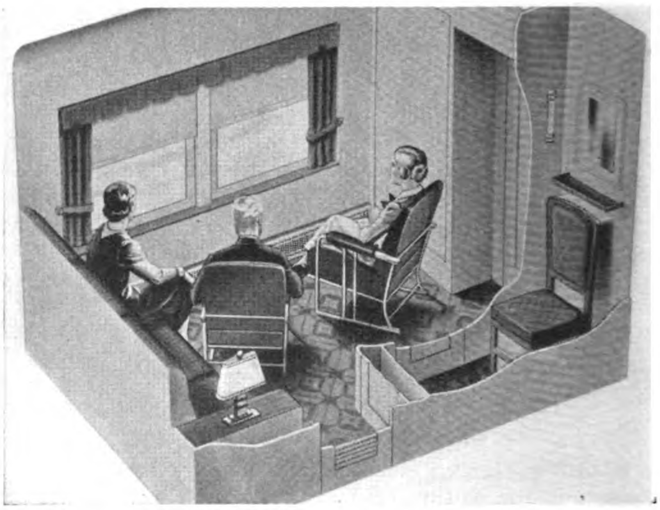
Spaciousness results from the new interior arrangement of the compartment

rack for luggage; a vacuum water bottle in a niche at the bed head, and a box from which the porter can remove shoes without disturbing the sleeper. Ceiling and reading lights of new design provide ample illumination. One daytime novelty is an adjustable footrest that can be pushed aside when not desired.

As the roomette is completely air-conditioned the passenger can enjoy his pipe, cigar or cigarette, knowing that the smoke will be withdrawn almost immediately through a grilled outlet, and without discomfort to those in adjacent roomettes.

The New Drawing Room

Spaciousness is the impression received by travelers entering the new drawing room in the daytime. The enlargement has been attained by rearrangement of facilities, such as absorbing into the room the space previously occupied by the toilet annex and the entrance lobby, and then building a very compact annex in an aisle corner of the room itself. A bed folding into one end wall has been substituted for the old fixed couch; the section seats by the windows have been removed, with substitution of a long transverse sofa, convertible into an equally long bed (with an upper berth) along one wall of the room. The folding bed when ready for night service is at right angles to the others, along the window wall. All three beds are 6 ft. 5 in. in length and of standard berth width. When the room is prepared for three persons, with the two full-sized lower beds in place and the upper also made down, there is still ample



The rearranged drawing room is a spacious living room by day

dressing space, also easy, unobstructed access to the annex, to the clothes closet and to the doors to the passage way and adjacent room.

For day travel the wall bed disappears, the upper is put away and the third bed becomes a sofa. This leaves ample space for the two comfortable, movable lounge chairs, giving a real living room effect. The chairs are of folding type, and at night are placed under the wall bed.

The drawing room not only has an electric fan but is provided with individual regulation of lighting and ventilation, and thermostatic control of the heating, which can be regulated however to suit individual tastes. Then there is a wardrobe in which to hang clothes; storage space above the annex for luggage, with additional pieces going under the sofa, and a shoebox opening on the passage way. The lighting consists of an especially designed ceiling fixture, a reading lamp on a table at one end of the sofa, and other illumination where needed.

The New Compartment

The new compartment is another example of obtaining additional space comfort through rearrangement. Gone are the section seats by the windows, replaced (as in the drawing room) by a transverse sofa occupying nearly the entire width of the room. The upper berth remains above the window, and is at right angles to the convertible sofa-bed. There is space between the sofa

and the opposite wall for a comfortable lounge chair. At night the chair is placed out of the way, under the upper berth; but even then it is available for lounging and reading. Occupants are therefore provided during the day with a comfortable sofa on which they may sit or recline, and also an easy chair. As in the drawing room, both beds are 6 ft. 5 in. in length and of standard berth width.

The compartment also has an electric fan, individual regulation of lighting and ventilation, and thermostatic heat control. Each compartment is provided with complete toilet facilities, a wardrobe for cloths, a shoebox, and the latest designs in lighting fixtures.

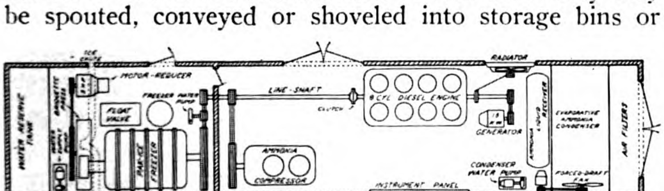
Diesel Engine Powers Mobile Ice Plant

Declared to be the first of its kind in the world, a self-contained, mobile refrigeration plant all housed in a standard freight car is now in service. The ice making equipment was made and installed by the Vilter Manufacturing Company, Milwaukee, Wis., and consists of a Pak-Ice briquette machine, ammonia compressor, evaporative condenser, liquid receiver, generator, pumps and fuel and water tanks. The power is furnished by a 160-hp. eight-cylinder V-type Caterpillar Diesel engine. A diagram of a complete installation is shown in the drawing.

Although this outfit has been in service for only a short time, it has been found to have many advantages, two of which are economical operation and instantaneous production. It attains full capacity production in 20 min. With an average price for Diesel fuel of 6 cents per gal. and an average consumption of 4.9 gal. per ton of ice produced in this mobile plant, the cost per ton of ice is 31.5 cents.

This track ice unit was designed especially for icing refrigerator cars. It is entirely independent of outside power and resources, with the exception of water, and this feature permits its operation when and where desired. It has been pointed out that some agricultural communities require ice for only one or two months out of the year, making a permanent ice plant impractical. Formerly, ice had to be brought in from distant points at prices as high as $8.00 per ton. Including power, labor, water and depreciation, the new mobile unit can produce ice in these communities at a small fraction of this figure.

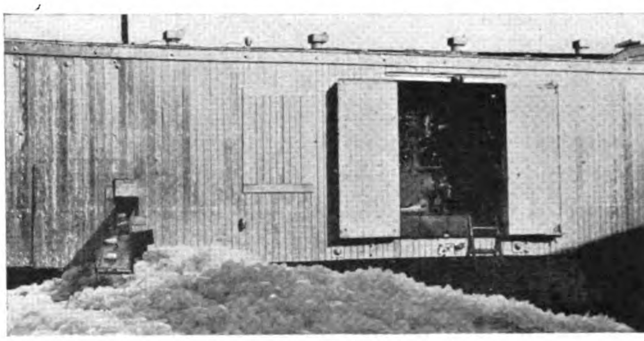
Briquettes can be turned out from this unit in any of four sizes, ranging from 2 oz. to 1.6 lb. each. Automatically ejected from the press, they are spouted out of the car through small openings in the side wall as shown in one of the illustrations. From there they may be spouted, conveyed or shoveled into storage bins or



Floor plan for Mobile Pak-Ice unit

directly to the point of use. Both briquettes and ice in a snow or crystal form for layer icing of fruit and vegetables may be produced by the unit. The briquettes can be used for car icing or space cooling as their rounded shape provides for free circulation of air.

The Caterpillar Diesel engine operates at 850 r.p.m. The engine exhaust passes through a water heater and then to a Maxim silencer or muffler mounted on the roof. Fuel oil is carried in two tanks of 435 gal. capacity fastened underneath the floor of the car, this capacity being sufficient for 80 hrs. of operation. A twin-cylinder gasoline engine of the horizontal opposed-piston type is mounted at the rear of the Diesel and is used as a start-



Ice briquettes discharged from chute and piled outside of the car

ing engine. The Diesel crankshaft extends beyond the engine block on both ends. One end of the shaft drives a 15-kw. d.c. generator by means of a V-belt connection. Thus, all electric power needed for lighting, for pump, fan and other auxiliary motors, and for the automatic control and safety devices, is supplied by the unit itself. The other end of the shaft is connected by means of a frictional clutch to an 8-ft. line shaft running slightly above floor level. This drives the ammonia compressor and the Pak-Ice freezer. A Vilter 8½-in. by 9½-in. single-acting, vertical twin-cylinder ammonia compressor is V-belt driven from the line shaft. The freezer, also driven from this line shaft, has a capacity of 30 tons.

At the back end of the car there is a reserve water

Mobile Vilter Pak-Ice unit of 30 tons capacity installed in a standard car

tank with a capacity sufficient for 1-hr. operation. The tank is equipped with an automatic switch operating an alarm bell whenever the water level becomes low. At the front end of the car is an intake opening for 16 air filters of 13,000 c.f.m. capacity at a velocity of 300 ft. per min. These filters provide air for the condenser.

Next to the Diesel engine is an opening in the wall for the radiator of the engine-cooling system. The fan is V-belt driven from the crankshaft by a quarter turn pulley arrangement. Both the Diesel cooling and lubrication systems have an alarm feature in case of supply failure. A gage panel on the wall opposite the Diesel contains the suction and discharge pressure gages for the compressor, fuel oil gage, and the various generator and automatic control switches and instruments. The Diesel engine which drives this plant is of typical "Caterpillar" design. Features of the engine are individual fuel pumps for each cylinder, solid injection, positive starting by means of a small two-cylinder gasoline starting engine, full protection by use of fuel, lubricating oil and air filtering system, and a precision-built fuel system.

EDITORIALS

The Atlantic City Exhibit

It is almost seven years since the last big railway mechanical exhibit was held at Atlantic City. During these years, in spite of the depression period, a great number of improvements have been made in the design of locomotive and car parts, in maintenance and repair facilities, and in the development of new equipment designs. The manufacturers and railway supply interests have not had the same facilities for bringing these improvements to the attention of the railroaders far and wide, as was true in the pre-depression days. Meanwhile, there has been a great change in the mechanical department supervisory forces. Many of the older supervisors have retired and the younger men who have been promoted have had little or no opportunity of seeing the new devices and improved facilities demonstrated.

It was for these reasons that the members of the General Committee of the Mechanical Division and the officers and executive committee of the Railway Supply Manufacturers' Association, rather enthusiastically agreed some months ago that it would be wise and in the best interests of all concerned to hold the convention at Atlantic City this year, and to parallel it with an exhibition, which promises far to surpass anything that has yet been held. In discussing the matter it was quite clearly brought out that the railroads could benefit greatly by having as many of their supervisors as possible attend the convention and carefully study the exhibits. In effect, it will be a small university and should be taken advantage of in that spirit.

Moreover, because of the large interest which the public has shown in railroad improvements in recent years, it was felt advisable to set aside the Saturday and Sunday between the conventions, so that the exhibits could be thrown open to the general public. Undoubtedly special trains will be run from the larger cities in the East, so that those who desire may spend the week-end in visiting the exhibition in the Auditorium and the track exhibit located near the railroad station. The Purchases and Stores Division, A.A.R., will hold its three-day convention on June 21-23. In addition, the Association of Railway Electrical Engineers will hold a one-day meeting on Thursday, June 17. The Air Brake Association is also arranging for a two-day meeting at the Haddon Hall on Thursday and Friday, June 17-18.

To insure the best results from the exhibit two things are important. First, that the groups from each railroad organize in such a way as to cover the exhibit thoroughly, and, second, that the exhibitors make every reasonable effort to make their displays as educational, in a practical way, as possible. The exhibit will entail a tremendous amount of expense, but if it is properly used, it will enable the exhibitors to bring their devices and equipment to the attention of railway officers and supervisors with a minimum of expense per railway supervisor as compared to other methods of approach. Since, in the last analysis, the railways will have to pay for the exhibit, even though the out-of-pocket expense comes from the exhibitors, it is important that every reasonable effort be made to capitalize upon the opportunities which are offered.

Clearing the Decks For Action

Throughout the depression the railroads of the United States were quietly going about a job of preparing for the future which is of unusual significance at the present time. Those who have lived with the railroad problem for many years saw the curtailment of operations result in the storing of thousands of cars and locomotives until, at the bottom of the depression, it looked as if most of the equipment were laid up on side tracks.

The designers of equipment did not, however, place their ideas in storage. The depression years saw the introduction of new forms of equipment which have resulted in attracting new freight and passenger business and made it possible to operate with greater economy. It was to be hoped, and now seems to be an actual fact, that a very large part of the obsolete equipment that the depression forced out of service will not now ever be returned to service but will be replaced, in the coming years, with modern, efficient equipment. In fact, during the seven years 1930-1936, inclusive, 514,000 more freight cars and 12,000 more locomotives were retired than were installed, a situation which sets the stage for the installation of modern equipment just as fast as more capacity is required.

What happened in the motive-power and rolling-stock field was spectacular because it was plain to be seen by everyone connected with the railroads. In the background, however, another change was taking place in the field of shops and shop equipment. The old, small, inefficient repair shops were closed and the operations transferred to repair points better equipped to handle them economically. This was not the entire

extent of the change, however, for even in the big shops it was realized that the closing down of many of these smaller plants would eventually place a load on the principal repair plants that would tax their capacity when the business returned to normal.

One of the first indications of what was happening was observed over five years ago in a large shop when, on a visit after several months, the absence of many machine tools was decidedly noticeable. Questioned as to the reason the shop management informed us that many machines not immediately needed had been scrapped so that, when business picked up, there would be no alternative but the installation of modern tools. Back in 1935 another road retired 135 old machines and purchased modern equipment. In 1936 this paper carried the story of the replacement program on the Reading where 49 old tools were retired and modern machines installed. In the past year numerous such instances have come to our attention. Only within the past month the retirement of over 100 obsolete machine tools on one small road came to light. Retirements of shop machinery and equipment in the United States as a whole in the six years, 1930 to 1935, totaled over 30 million dollars, at an average annual rate of about five million dollars, while expenditures dropped over 80 per cent from 1930 to the low point in 1932, indicating a general disposition on the part of the railroads to pave the way for new shop equipment installations just as in the specific cases cited above.

Railroad buying of machine tools and shop equipment has got under way during the past 12 months. This is only a start, many extensive programs of modernization of car and locomotive repair shops are now being formulated.

Intra-Shop Transportation

The statement has been made that American industry spends about eight-tenths as much for the intra-shop transportation of material in the process of manufacture, as it spends on freight charges for raw materials and finished products combined. Obviously, this is a general statement which might be questioned, but if even approximately correct, it serves to emphasize the necessity of utilizing fully all types of equipment which promise to save labor in handling materials in all plant movements.

Railroads, as well as manufacturers in general industry, have already given considerable attention to this subject for it is especially vital in all railroad shops and engine terminals. Motor-driven tractor and trailer equipment, trucks equipped with electric cranes, lift trucks and skids are extensively installed to say nothing of electric shop cranes of various types, mono-rail systems, electric and pneumatic hoists, etc. In some instances the lift-truck and skid method of handling materials, for example, has been carried to the extent of loading heavy repair parts and processed materials on skids at a central repair shop, then moving the loaded skids to the store room, from which they are placed in a freight car and moved to the final point of use before the material is removed from the skids. This method requires a rather substantial investment in various types of skids and may conceivably be carried too far, but the principle is sound and within economic limits will unquestionably result in substantial savings of time and labor.

Specific evidence of the advantages of handling materials on skids was indicated in a survey conducted by the Department of Commerce several years ago which showed at that time a saving of from 25 to 90 per cent in the cost of handling materials on skids, as compared with older methods. In view of the savings which may be anticipated, there are probably few railway shops and terminals in the country in which it would not pay to make a re-survey of material-handling methods and make sure that full advantage is being taken of modern equipment and facilities to the fullest extent practicable in reducing this important item of shop-operating expense.

Fatigue Strength Of Press Fits

The recent articles by F. H. Williams on the failure of locomotive parts brings to mind the excellent work in research laboratories in this country and abroad undertaken to determine methods for increasing the fatigue strength of press-fit assemblies. Tests have proved that the fatigue strength of small press-fitted axles may be reduced to as little as one-half or one-third of their original strength. This is also true when crank pins are press-fitted in driving wheels, and when tapered piston rods are pulled into crosshead fits. Such reduction in fatigue strength is caused by (1) a concentration of stress at the end of the press fit where a small radius or shoulder is formed, (2) the location of a peak pressure between the two fitted members due to end restraint, and (3) corrosion at the edge of the fit resulting from a sliding action of the hub edge caused by contraction and expansion of the pressed-in member. In the past relief grooves in the pressed-in member, raised seats, and alloy or heat-treated steels have been used to relieve such stresses and prevent fatigue failure.

The tests previously referred to for studying fatigue failure involves surface rolling of the fit on the pressed-in member. This involves no new procedure for railroad men since plastically compressing wearing surfaces by rolling or burnishing has long been used in the railroad field for producing smooth wear-resistant surfaces for journal bearings. However, it was not until 1928 that O. Föppel at the Wöhler Institute in Braunschweig, Germany, discovered that increased fatigue strength of press-fit assemblies could be obtained by surface rolling.

Although there is considerable difference of opinion as to why surface rolling increases the fatigue strength of these fits, tests made since Föppel's original tests have shown that such increases are effected. For example, tests conducted by A. Thum in Germany in 1933 revealed the fact that rolling the axle surface gave about the same strength as the axle without the press fit or an improvement in fatigue strength of 69 per cent. These tests, and others made concurrently in this country, have used specimens up to 2 in. in diameter. However, they have proved the value of surface rolling as a means for increasing fatigue strength, and it can be assumed that benefits derived therefrom for small axles will also apply to full-size locomotive axles.

Tests made in this country in 1935 by O. J. Horger and J. L. Maulbetsch of the Timken Roller Bearing Company with 2-in. axles have shown that in each of two cases the application of surface rolling gave a fatigue strength about two and one-third times as great as without rolling. The tests were conducted with press-fit bearing races on the 2-in. axles, the fatigue strength of which without surface rolling after pressing on the race was 15,000 lb. per sq. in., and the strength after surface rolling was 33,000 lb. per sq. in. The original fatigue strength of the axle before rolling and before pressing on the race was 34,400 lb. per sq. in. The fatigue strength of 33,000 lb. per sq. in. was obtained after surface rolling at a roller pressure of 600 lb. An increase of this pressure to 1,200 lb. increased the fatigue strength of the pressed-in member to 34,000 lb. per sq. in.

The importance of rolling the surfaces of pressed-in members has made definite impressions as to its value even though most of the available data are for small specimens. However, some application has been made to full-size locomotive axles which have been failing at the wheel seats. In this instance the axles were first ground and then rolled at a pressure of 25,000 lb. per roller, which caused a reduction in diameter up to 0.001 in. Sufficient mileage has not been run on these axles at this time to determine what benefit may result. Future data on the subject may ultimately become available through the axle-testing machine recently installed in the laboratories of the Timken Roller Bearing Company, which is described elsewhere in this issue.

Economy in One Shop Operation

The use of turret lathes for machining locomotive tapered bolts seems to offer a field for study in reducing shop operating costs, event though it requires careful maintenance of reamers and constant-speed motors for the production of reamed holes from which bolt sizes can be obtained by plug gages. Elsewhere in this issue is described the means employed in one large railroad shop for machining over 300 bolts per day on one machine—all the bolts necessary for repairs to freight locomotives.

In observing the operation of this machine, one cannot help but contrast the machining of bolts in some shops on small engine lathes operated by apprentices or machinists who obtain hole sizes by calipers and set the taper to suit each bolt by tailstock adjustment. The value of such procedure is not underestimated from either an apprentice-training viewpoint or from the standpoint that the quantity of bolts required may not warrant the use of a turret lathe. However, the consideration of reducing shop operating costs warrants a study of what turret lathes can do in this particular shop operation.

New Books

Agenda Dunod Chemins de Fer. *By P. Place, chief engineer, Central d'Etudes de Materiel de Chemins de Fer. Published by Dunod, 92, Rue Bonaparte, Paris. 407 pages. Price, 22.85 francs.*

The Dunod agenda of railways contains chapters on right-of-way, motive power, car equipment, and operation. The right-of-way section of the 1937 edition has a table of track lengths and studies on ties of wood, metal, and reinforced concrete, and ties of wood and steel. The section on motive power discusses the resistance of trains, tractive force of locomotives, etc. Various types of passenger and freight cars, brakes, and heating and lighting of cars are among the equipment described in the section on car equipment. The section on operation contains data on safety devices, tariff receipts, taxation, etc. Miscellaneous data on steam engines, ferry boats and canals are also contained in this edition.

Metal Statistics, *Thirteenth Edition. Published by the American Metal Market, 111 John street, New York. 592 pages, 4 in. by 6 in. Price, $2.*

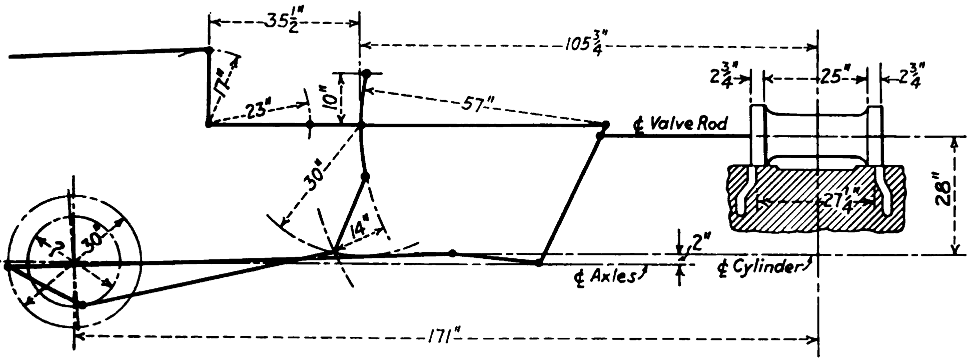
The thirteenth edition of Metal Statistics contains the same general statistical information on ferrous metals and non-ferrous metals and miscellaneous economic subjects as has appeared in earlier numbers. Most of the iron and steel production statistics are gathered by the American Iron & Steel Institute, while the production statistics on metals are, with a few exceptions, based mainly on figures furnished by the U. S. Bureau of Mines and the American Bureau of Metal Statistics. The Copper Institute, Inc., has also released certain figures which permit a more comprehensive presentation of statistics on copper. Prices given in this volume are based mainly on the daily quotations appearing in American Metal Market and represent wholesale selling prices.

THE READER'S PAGE

A Tough Valve Problem

To the Editor:

We have operating over one of our divisions six passenger locomotives of the 4-8-2 type, with 27-in. by 30-in. cylinders, carrying 200-lb. boiler pressure. The piston valves are 14 in. in diameter, driven by the Walschaert gear. The lead is ¼ in.; steam lap, 1⅛ in.; exhaust clearance, ¼ in.; port width, 1⅞ in.; travel in full gear, 6½ in.; eccentric crank, $18\frac{9}{16}$ in.; eccentric-crank throw, $20\frac{11}{16}$ in.; link radius, 57 in.; link foot 30 in. from link trunnion and offset 14 in; combination lever, 3¼ in. (top) by 31¾ in. (bottom); trunnion link, 20¼ in.; eccentric blade, 58¾ in.; main rod, 102 in.; center line of cylinders 2 in. above center line of axles; valve 25 in. between admission edges and 30½ in. over exhaust edges; between admission edges of valve ports 27¼ in.; direct in forward motion: link slotted 12 in. above and below trunnion center. The driving wheels are 69 in. in diameter.



Can you tell why a valve gear with this layout causes pounding in 25 per cent cutoff?

These locomotives are reported as pounding badly at short cutoff; due to this condition the main axle bearings and main-rod bushings are renewed often. Several tests have been made by our traveling engineer riding these engines on their regular runs to ascertain at what position the reverse lever should be placed on the quadrant to overcome this compression kick. He has decided that at no time should the lever be worked closer than one inch from the center of quadrant. In checking the cutoff with the reverse lever in this position we find that cutoff was occurring at 43 per cent of the stroke. We then marked a point on the quadrant that would indicate to the engineman that he was working his engine at 25 per cent cutoff. He then reports bad compression kick at 25 per cent, but all right at 43 per cent, except that the boiler requires too much water, which results from greater steam consumption at the longer cutoff.

What is wrong with the valve gear that 25 per cent cutoff cannot be used? We have had these engines on valve rollers several times trying to find a solution; so far no changes have been made.

What length eccentric crank should be used with $20\frac{11}{16}$ in. throw to give ¼ in. constant lead? Will the $18\frac{9}{16}$ in. eccentric crank with $20\frac{11}{16}$ in. throw give a constant lead? What effect would an eccentric-crank throw of 21⅝ in. with an $18\frac{9}{16}$-in. crank have on the cutoff? What changes could be made in the valve design to eliminate excessive compression kick at 25 per cent cutoff.

K. B. G.

Interchange Rules 68 and 75 Inconsistent

To the Editor:

It was with much interest that I read in the March issue of the *Railway Mechanical Engineer,* the excerpts from J. C. Hayes' paper before the Eastern Car Foreman's Association in New York, January 8, 1937. I heartily concur in Mr. Hayes' proposals. He shows by his suggestions that he has a sympathetic understanding of the problems of the car inspector.

I was especially interested in that particular clause with reference to responsibility for cut journals, which coincides with the thought I expressed in my article in the *Railway Mechanical Engineer,* March, 1936, captioned, "Are Interchange Rules 68 and 84 Fair?" In that article I attempted to analyze the causes of slid flat wheels and cut journals and expressed the thought that such defects should be conditionally classified as owner's responsibility.

The inconsistency of Rule 68 is apparent when you realize that this rule is classed as delivering line responsibility and Rule 75, brake burns, is classified as a handling line responsibility, when both defects are produced under identical conditions. Both defects are the result of one of the three following causes—defective brake mechanism, improperly proportioned or adjusted brake rigging, or moving car with hand brakes set too tightly. I think that any practical car department supervisor will agree with me when I say that approximately 90 per cent of wheels removed from cars, account of being slid flat or brake burned, were due to the first mentioned cause, the degree of damage depending more or less on the adjustment of the brakes.

If the brake rigging is properly adjusted and full braking power applied, the wheels will be slid flat. When the air brake fails to function properly, if not too tightly adjusted, the result may be brake burned wheels. Hence, as the condition of the air brakes and brake rigging is definitely owner's responsibility, why should not slid flat wheels found under cars having these parts de-

fective, or improperly adjusted, be designated as owner's responsibility, as is the case with brake burned wheels? But there should be a qualifying clause in the rule to fix the responsibility on handling line for sliding wheels when caused by moving car with hand brakes set. In the absence of any definite information it will be assumed that wheels were slid flat as result of handling the car with hand brakes set, if the air-brake test shows the brakes to be properly operative, and a check of the brake rigging shows it to be properly adjusted and proportioned.

It is unreasonable to hold the handling line responsible for the development of cut journals on foreign cars in its possession, when the main contributing factors in the development of this defect are all classed as owner's responsibility. Let us summarize these factors: Worn, defective or improper fitting journal bearings and wedges; worn or missing dust guards; journal-box lids missing or improperly fitted; inferior packing; trucks out of alinement; mal-concentricity of wheels, due to slid flat, worn chill or improper boring. The correction of any or all of these conditions is properly chargeable to car owners; hence, if a car develops a cut journal as a result of any of these conditions, this, too, should be charged to the car owner.

If any program to reduce the issuance of defect cards in interchange is advanced in line with Mr. Hayes' proposal, and I think there should be, these two propositions should be given consideration, as they no doubt account for a vast number of defect cards issued in interchange.

The views of individuals in proposing modifications in the rules of interchange cannot always be gotten over to the A.A.R. committees, but they can be put before the proper committee when endorsed and properly presented by car foremen's and interchange inspection organizations. Hence I would suggest that secretaries of such organizations, throughout the country, bring these matters to the attention of their respective organizations for discussion.

H. A. McConville,
Foreman, Car Department, Louisville & Nashville.

Carrying Scrap In the Storehouse

To the Editor:

In your publication for December 1936 there appeared on the reader's page under the heading of "Carrying Scrap in the Storehouse" an article by W. H. Shiver, which, in my opinion, contains several statements as facts in regard to the dismantling of equipment and purchase of second-hand parts that can hardly be substantiated if investigation were made as to actual practices on various railroads. It is regrettable, of course, if conditions described by Mr. Shiver exist on any road, but the statement that such conditions generally exist should, we feel, not pass by without challenge.

The article referred to states: "Since 1929 large numbers of cars have been retired. The majority of this equipment has been dismantled by contractors who sell back to the railroads whatever material they wish." The facts of the matter are that approximately 70 per cent of all cars being destroyed are dismantled by railroad forces and not by contractors. Sixteen per cent of all cars being dismantled are handled by contractors but with the railroad company reserving the right to retain or re-purchase certain materials. This leaves only approximately 14 per cent of dismantled equipment that is being sold on wheels without any reservation as to return of usable materials.

These figures clearly indicate the error in Mr. Shiver's article in stating that the majority of the dismantling work has been done by contractors. As a matter of fact, the Purchases and Stores Division of the A.A.R. has for many years recommended that dismantling of cars should be done by the railroad company's own forces unless there are some unusual circumstances which would make the sale of the equipment on wheels to contractors advisable.

Mr. Shiver's article also contains the statement that large amounts of car materials such as truck springs, brake beams, couplers, truck sides, etc., have been purchased from contractors dismantling equipment and that much of this material is not up to A.A.R. specifications, resulting in delays to the Mechanical Department as well as loss of money in purchasing these materials at a premium over their scrap value.

If such conditions exist, we cannot but feel that it is the exception rather than the rule. Our investigation indicates that, where roads have found it desirable to purchase such second-hand material from dismantling contractors, they have arranged for just the same care in the inspection of this material by the engineer of tests or other inspection forces as they would use in the inspection of new materials. If such inspection was not arranged for, it is a man failure which should be corrected locally; and it would be well for the officers in charge to acquaint themselves thoroughly with the recommendations of the Purchases and Stores Division, A.A.R. on this subject.

In conclusion, for the benefit of those under whose jurisdiction such activities fall, I would like to call particular attention to the following from the 1926 proceedings of the Purchases and Stores Division annual meeting:

"Inspection of reclaimed materials—No reclaimed materials should be furnished for use until they have been inspected and accepted for the service intended by the using department or the authorized inspection department as nothing will more rapidly discredit the reclamation enterprise than to attempt to furnish materials that do not meet the required specifications or are unsatisfactory for the use furnished."

Many other recommendations from the Purchases and Stores Division, A.A.R. in regard to the dismantling of equipment by railroad company forces and other reclamations practices could be cited but space will not permit.

Generally speaking, we cannot agree that conditions are as described by Mr. Shiver, but, if such conditions do exist on some individual railroad, then the remedy for correction can easily be applied on that property by dismantling its own equipment if possible which will permit retaining usable second hand materials and avoid purchase from contractors. In case this is not possible, then an arrangement for proper inspection of materials purchased should be inaugurated so as to insure only good usable material being accepted.

J. C. Kirk

Line-Smashing Superintendent.—J. J. Gallagher, recently promoted to superintendent of the North Texas division of the Missouri-Kansas-Texas, on which division he has been division engineer for several years, is probably the only railroad superintendent with an All-American football background. In fact, Gallagher was the first player west of the Mississippi to be selected on Camp's All-American team. He did his playing at the University of Missouri.

Gleanings *from the* Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

Walt Wyre Took a Vacation

I must say that your short stories by Walt Wyre are anxiously looked forward to, but for the past few months no Wyre. He must have been around some, as the stories are right in accord with present-day problems on any railroad. I may be the only one that looks in the index to see if Mr. Wyre has a story. He put the humor in the magazine, and everyone enjoys true humor and fun. (Walt Wyre is back again in this issue. You are not the only one who let out a howl about his absence. His return will cut down our correspondence and postage costs.—Editor.)

Make Best Use of June Conventions

The A. A. R. convention with its exhibit at Atlantic City in June will be the first in seven years. During this time many improvements have been made in old devices and many new devices have been brought out. It seems to me that this will give the railroads an opportunity to educate their younger supervisory forces with reference to the new and improved devices that have been developed by the supply companies during this time. We know that railroad forces in all departments were cut to the bone during the depression we have just gone through. If this matter could be brought to the attention of the proper railroad officials they would, in all probability, arrange to have a number of their younger supervisory staff attend the convention, if only for a day or two. It seems to me that the opportunity to compare competitive devices and have them explained is one that they should not have overlooked.

How About Raising Bull Frogs?

I have just noticed the agreement between the railroads and the labor unions in connection with the railroad pension law. The clause in this ruling or agreement which bothers me is under Section 8: "No annuity will be paid any employee who retires and engages in regular gainful employment in some other line of work." I am interested in knowing just how this ruling is likely to be interpreted. Being just as active mentally as I ever was in my life, so far as I can tell by comparisons which I have made very carefully, I have been planning certain activities when I reach the point of my forced retirement. For instance, I have purchased a farm with the expectation of operating it. I do not care to be retired and sit down and twiddle my fingers. According to life insurance standards, my life's expectation when I retire will be in the neighborhood of ten years. If I live to be as old as my father, it will probably be 14 or 15 years. I feel very sure that what is really intended by the pension agreement is that where people are working for someone else they cannot accept employment elsewhere, but if a man has sufficient capacity to project an organization for production and employs labor, or is in a position to use his previous experience and initiative to produce things, such as inventions and the exploitation of same, or consulting engineering work or similar things, that he will not be put in the category of the craftsman or laborer, or the man that has to be directed in his work and is employed by the day. I have a friend who is to be retired just before I do, and he like myself is active mentally. He has been thinking of starting a duck farm, and jokingly he said he wondered if they would interfere with him if he went into bull-frog raising.

Why Cars Fail on Line

The "Car Failures on Line" (Gleanings page, your March issue) can, with very little thought, all be traced to inadequate time allowed to inspect and repair cars properly. In each of the items mentioned, if time was allowed for careful inspection before the cars left a terminal, and if they were not allowed to leave unless they were actually fit for service, there would be no problem, let alone a big one. Most every mechanical failure, certainly all that are mentioned, can be traced back to some carman who didn't have, or wouldn't take, sufficient time to do his work properly. Ninety-nine times out of a hundred, the only reason why car inspectors take chances with cars is because of a lack of understanding of switchmen, yardmasters and dispatchers on what a car and a carman can do in a given length of time. When one inspector is required, or supposed, to "inspect"—properly speaking, race around—from 80 to 100 cars in 30 to 45 minutes, the railroads have no cause for complaint. If the delays that result from such haphazard "inspection"—seeing that they have wheels, are coupled and with nothing dragging—have caused loss of business and other unnecessary expense, the railroads have only themselves to blame.

Waste — In More Ways Than One!

I have wondered many times why, since freight cars are interchangeable and sometimes spend most of their time on foreign lines, we cannot use a common standard waste in the journal boxes. I agree with Vice-President C. E. Smith of the New Haven in his statement at the December meeting of the New England Railroad Club: "One railroad," he said, "will buy a very expensive waste and another railroad will buy a very cheap waste. I don't understand why mechanical men will travel long distances, send out questionnaires, assemble information, sit down and consider all of the information in committee meetings, at great expense to the railroads, and finally adopt specifications; then everybody goes home and pays no attention to the specifications whatsoever. Why do we choose the specifications in the first place if they are not to be followed? * * * There is an agency of the railroad that has authority that has been given to it by the railroads to make research that is necessary and adopt proper specifications. That is the Association of American Railroads."

The Three-Legged Stool

In comments on the Wagner Act and the relations between capital and labor which have appeared in the newspapers recently, reference has been made to the successful way in which these matters have been handled in the railroad field. I am afraid that these commentators have overlooked the way in which some of the railroad labor leaders are working outside of these agreements and are attempting to bring political pressure to secure unwise legislation. President John M. Davis of the Lackawanna Railroad made a very pertinent suggestion in his address before the annual dinner of the Central Railway Club in Buffalo. "In connection with labor and management," said Mr. Davis, "I read a little article the other day that amused me. This story said that a newspaper reporter asked Mr. Andrew Carnegie, in an interview in Pittsburgh, which was the most important in business—management, capital or labor. Mr. Carnegie's reply was a question—'Which is the most important leg under a three-legged stool?' Everyone wants more money and more leisure, but further reductions of hours would reduce employment. In my opinion, the shorter work day would increase railroad payrolls to the extent of about six hundred million dollars per year, or 33 per cent. The railroads, at existing rates, would be unable to meet that increased cost. The problem, therefore, presents new difficulties that warrant serious deliberation."

With the Car Foremen and Inspectors

Milwaukee Uses Plywood Extensively In New Cars

The Chicago, Milwaukee, St. Paul & Pacific, in the development of new passenger and freight cars, has produced many new standards, both in design and construction, over the conventional-type cars, the objective sought being modern cars light in weight yet safe and suitable for all interchange service.

One important departure has been the use of plywood in place of tongue-and-groove linings in the interior. While the initial cost of the plywood is greater, this is partially offset by the economical application of large sheets which eliminates a portion of the blocking and nailing strips formerly required, and which effects the labor cost. Further, the plywood has greater strength permitting of lighter sections. The following paragraphs cover in a general way the application of this material to the various classes of Milwaukee cars built in the past few years.

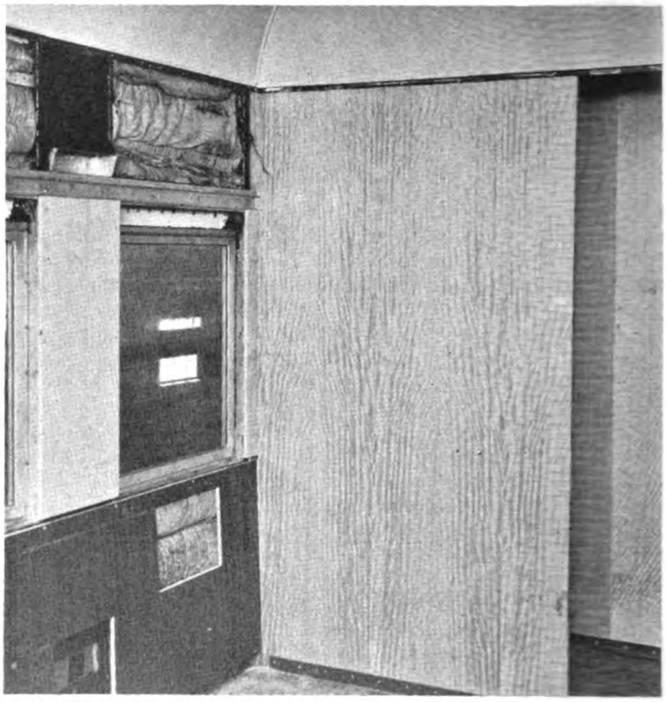
Passenger Cars.—During the past two years, the C. M. St. P. & P. has built at Milwaukee Shops over 100 new passenger cars, which includes coaches, baggage and mail, diners and other special cars. All of these cars embody all-welded steel construction, with a weight reduction in the case of the new coach, for example, to 90,000 lb. which may be compared with 160,000 lb. for a conventional riveted steel car. The application of plywood to the inside of these cars has been one of the features to obtain this weight reduction. In the case of new coaches, all of the flooring and partition panels are ¾-in. 5-ply fir plywood and, for the side walls, poplar or basswood plywood is used as a base for the imported veneer faces.

For the baggage and mail cars, due to the heavy loading, the floors are made of 1¼-in. 7-ply, side walls of ¾-in. 5-ply, and the ceiling ¼-in. 3-ply, all fir plywood. Over the floor and outside of the door openings 1-in. by 2-in. oak strips, spaced 1¼-in. apart, serve for two purposes, one to provide drainage for fish loading, and the other as a protection to the floor. In between the doors 1-in. tongue-and-groove oak flooring is applied as this section suffers greatest abuse.

Interior view of Milwaukee all-welded steel coach showing the application of plywood inside finish

Baggage cars with this installation have been in continuous service over two years and indications are that the material is standing up without apparent defects and should last for a substantial period of time before any replacements will be required.

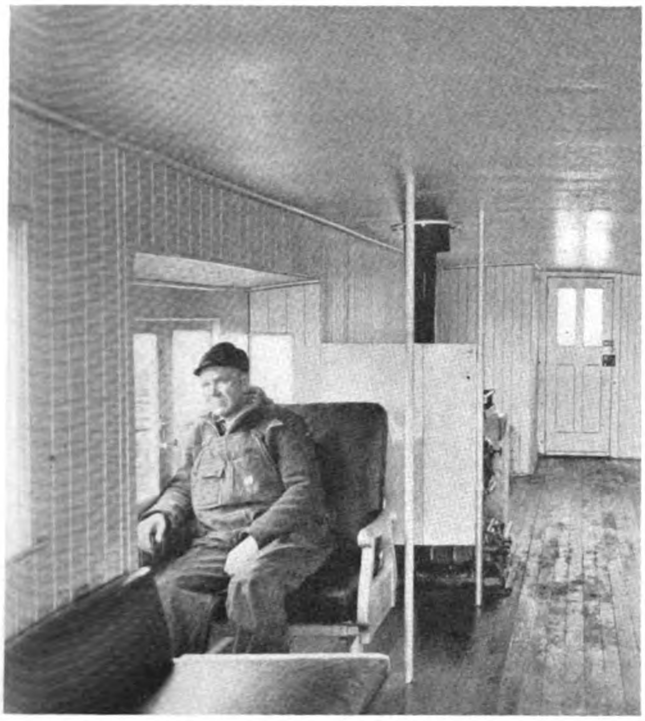
Freight Cars.—The first test application of plywood for lining Milwaukee freight cars was made in July, 1934, to an all-welded 40-ft. steel box car. Since then, this car has been loaded with such commodities as flour, grain, lumber, feed, mill work, etc., and has been handled repeatedly under load over long distances. There have been no complaints about the lading being damaged at any time due to defects within the car itself, such as rough inside finish, or by water, cinders or soot, seeping into the car.



Close-up view showing plywood partition panels in Hiawatha parlor car

On the strength of this showing it was decided to build 1,000 new automobile cars which were recently completed at Milwaukee Shops. The sides and ends of these cars are lined with ¾-in. 5-ply fir plywood and the ceiling with ¼-in. 3-ply fir plywood. All sections are fastened to fir strips bolted to the car body, and the plywood fastened to the fir strips with wood screws; at joints not backed up with fir strips ¾-in. by 4-in. plywood cleats are used.

The principal feature of this application was the method of applying the plywood which permitted re-

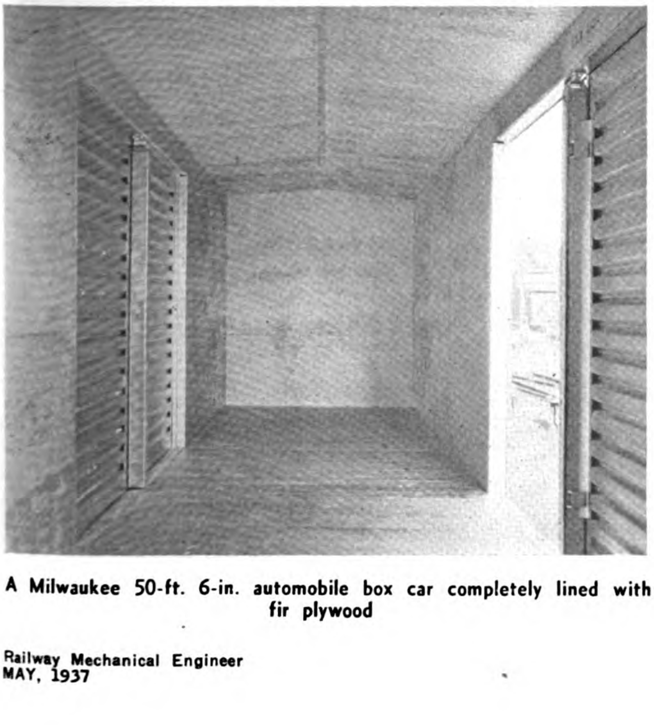


One of the rebuilt Milwaukee cabooses with ceiling made of plywood

moving either the flooring, sides, or ends, without affecting each other; also the plywood is attached directly to wood to prevent any metal to metal contact and to prevent any frost penetration through bolts or screws. For reasons stated above, the use of large panels has reduced the labor cost both from a milling and installation standpoint; also it provides a smooth interior finish.

Another feature is the ¼-in. plywood ceiling. This is a new departure from the conventional type of box car with a steel roof and is expected to eliminate, to a large extent, damage to lading due to the sweating of the steel roofs, which allows moisture to gather and drip on the lading. The complete inside lining of the automobile box car, including the roof, with plywood is clearly shown in one of the illustrations.

To protect the plywood panels from moisture, all panels were dipped in a Laucks sealer and as a further protection the backs of the panels are given one coat of



A Milwaukee 50-ft. 6-in. automobile box car completely lined with fir plywood

red mineral paint. After these panels are applied to the car, the entire face of the panels, which includes the floor, are sprayed with an aluminum paint, the latter having two purposes: first, from the appearance and cleanliness standpoint; and, second, as an additional precaution for moisture prevention.

While a weight reduction of about 9,000 lb. in the 50-ft. 6-in. automobile box car is due primarily to the welded construction, an appreciable part of this weight saving may be credited to the plywood lining. It is also interesting to note that in a derailment of some of these box cars, where the brakes were applied in emergency and the loads shifted enough to bulge the steel ends slightly, the ¾-in. plywood end lining was bent, but not split or broken, and came back nearly to its normal position as soon as the car was unloaded.

Caboose Cars.—Still another recent application of plywood to Milwaukee equipment is its use for lining the ceilings of some rebuilt cabooses, one of which is shown in an illustration. The principal feature of this car is the replacement of the conventional cupola with a bay window on each side of the car, but among other items of interest is the installation of a ceiling, made of ¼-in. 3 ply fir plywood and designed to improve the interior appearance of the car as well as to make it warmer in winter and cooler in summer.

Questions and Answers On the AB Brake

146—*Q.—What is the position of the piston at this time in relation to that of the emergency piston?* A.—It is to the extreme left, out of contact with the emergency piston.

147—*Q.—When does the service piston assume retarded recharged position?* A.—It assumes this position during release, at such time as the brake-pipe pressure is over 3 lb. higher than that of the auxiliary reservoir.

148—*Q.—What movement results from this differential?* A.—The return-spring, at the end of the service-piston stem, is compressed, as a result of which the piston, the slide, and the graduating valves are moved to the extreme right.

149—*Q.—What is the effect of the movement just described?* A.—One of the feed grooves in the service piston bush is closed, reducing the rate of flow from the brake pipe to the auxiliary reservoir.

150—*Q.—Does this movement take place all over the train?* A.—No. Only the front-end brakes assume retarded recharge position.

151—*Q.—What benefit is derived from this arrangement?* A.—While the front-end of the train is restricted, the brake-pipe and the auxiliary-reservoir pressures are built up on the rear portion at an increased rate, providing a uniform recharge throughout the train.

152—*Q.—Is the rate of brake-cylinder release the same in full release as in retarded recharge?* A.—Yes. The connection to the exhaust is the same in both positions.

153—*Q.—What eliminates the possibility of the service graduating valve becoming unseated during the initial charging of the equipment?* A.—The service slide valve blanks the service port, cutting off the flow of air to the graduating valve.

154—*Q.—When a service brake-pipe reduction is started, what movement of the service piston results?* A.—The piston moves far enough to the left for the spring guide at the end of the piston stem to engage the slide valve when the spring is slightly compressed.

155—*Q.—Is communication now open between the brake pipe and the auxiliary reservoir?* A.—No. Both feed grooves are closed by the piston.

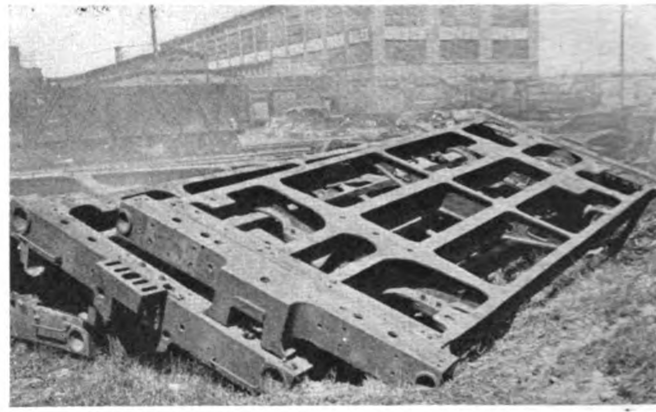
156—*Q.—In what capacity does the spring and the spring guide act?* A.—They act to stabilize what is known as the preliminary quick-service position so that a predetermined differential of auxiliary-reservoir and brake-pipe pressure is required to move the service piston and the graduating valve to this position.

157—*Q.—What does this prevent?* A.—This prevents undesired quick-service activity, induced by moderate fluctuations of the brake pipe-pressure.

158—*Q.—Should the brake-pipe reduction continue, what is the result?* A.—Sufficient differential is created to compress the piston spring, moving the piston and the graduating valve until the ports register via the slide valve, establishing communication between the brake-pipe and the quick-service volume.

159—*Q.—What is the result of this operation?* A.—A local reduction of brake-pipe pressure.

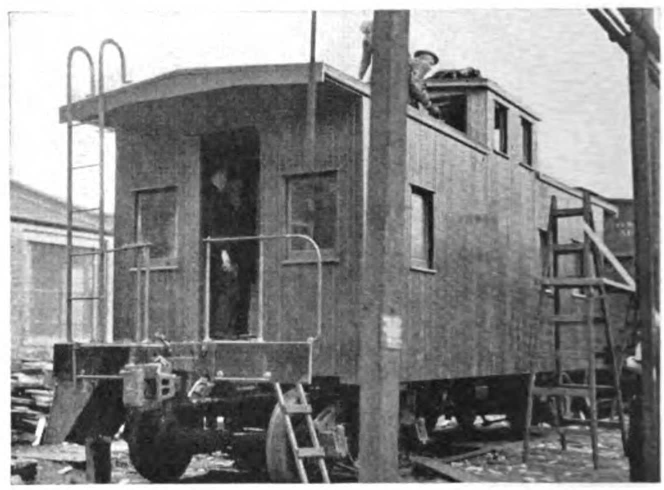
160—*Q.—What does this bring about, in so far as the train is concerned?* A.—This preliminary local reduction, controlled by the graduating valve, results in rapid-service action throughout the train.



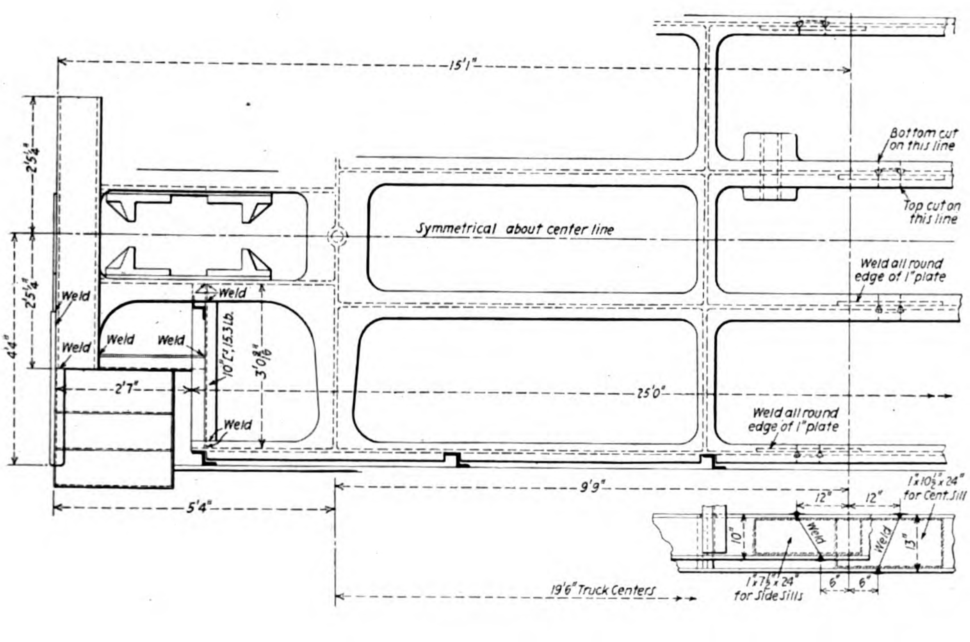
Two of the original locomotive tender underframes before cutting in two—The rear and front ends are shown in the top and bottom frames, respectively

Tender Underframes Converted for Caboose Service

An interesting example of the conversion of cast-steel locomotive tender underframes for caboose service is that involved in a recent rebuilding job performed by the New York, Ontario & Western at its Middletown, N. Y., shops. Because of the requirements of service this road found it necessary to equip new cabooses with heavier steel underframes than the former riveted rolled-steel design. Recently several locomotives that were equipped with cast-steel tender underframes were retired from service and it was desired to make use of these frames. It was, of course, not possible to use tender underframes as they were because of the fact that the front end sill of the original underframe was designed for the engine and tender buffer. Two tender underframes were therefore cut in two and two rear ends were welded together to form the caboose underframe. One of the illustrations accompanying this article shows two of the original tender underframes as removed from the locomotive; the drawing shows the reconstructed arrangement of the frame and the other illustrations show a rebuilt caboose nearing completion.



One of the cabooses with the cast-steel underframe being rebuilt



General arrangement of one end of the caboose underframe—The location of the welds in the four sill members is shown in the plan view and the manner of splicing the joint and applying the splice plates is shown at the lower right corner of the drawing

The splice in the frames was made about a transverse center line 15 ft. 1 in. from the frame end so that the completed caboose frame was 30 ft. 2 in. overall.

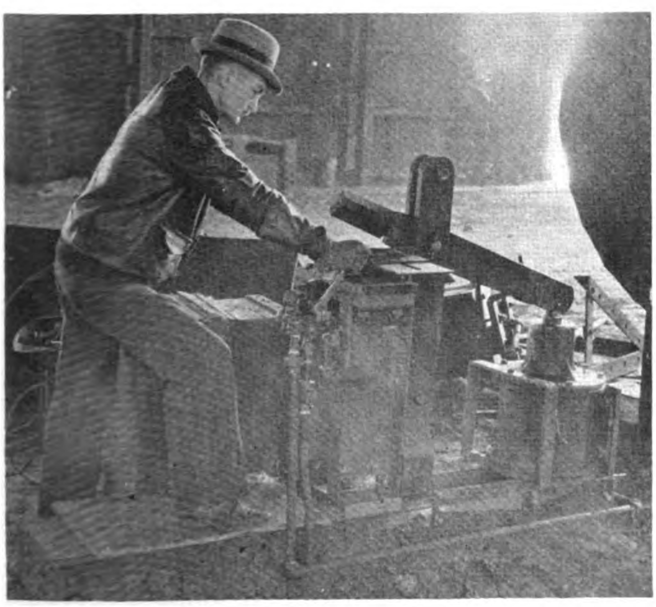
The splices in the outside members were made at a point 12 in. on one side of this center line and the splices in the inside members were 12 in. on the opposite side of the center line, so that the joints in the completed frame were staggered in location across the frame. The drawing shows clearly where the welds were made and the manner in which the splice plates were welded to the webs of the four members. The outer edges of the splice plates were electrically welded. All of the other welding was oxy-acetylene. The four sill members were welded simultaneously in order to obtain approximately the same expansion on each member, four welding operators being used on the job at one time.

Air-Operated V-Block

By A. Skinner

In the rebuilding of automobile cars, brackets of different shapes are required and, to speed up the work, it became necessary in one shop to find something more than an ordinary V-block such as is commonly used to bend one piece at a time. After experimenting with several different methods of making these brackets, the idea of using an air-operated V-block designed to bend three or more brackets in one operation was considered worth trying.

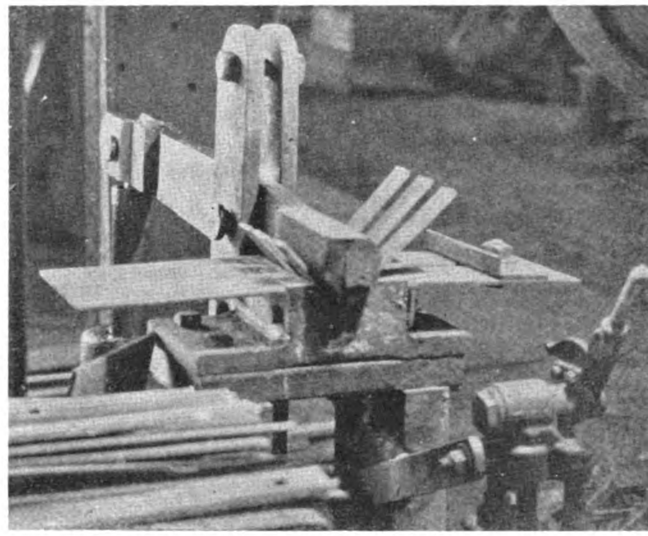
The result was the development of a shop-made device which consists of a V-block rigidly supported at a convenient elevation, a heavy lever arm and fulcrum and a 12-in. air-operating cylinder, all mounted on a substantial steel base. The base consists of two 6-in. channels with a 1-in. cover plate which may be either riveted



Shop-made device for forming uniform angle bends in steel brackets required for car work

or welded in place. The bottom die, or V-block, is a steel forging, provided with a vee of the proper angle and depth cut in the upper surface, and bolted to a rigid steel channel structure, about 24 in. high, firmly secured to the base channels. The fulcrum just back of this table is made of two pieces of 1-in. by 5-in. by 48-in. iron, bolted to the base channels and separated 1⅛ in. at the top so as to accommodate the lever which swings on the fulcrum pin.

The ratio of lever arms is two to one; the short arm, machined to the same angle as the V-block and subsequently case-hardened, is 12 in. long, and the other arm 24 in. long. This lever is made of 1⅛-in. by 5-in. stock, thickened at the operating end to 3 in., and provided with a substantial slotted jaw at the long end for connection



The work-supporting table and length gage—Three brackets have just been formed

to the push rod. The air-brake cylinder is secured to the base channels by being bolted to an end plate, and additional stiffness is secured by the application of a rectangular bracket made of ⅜-in. by 2-in. scrap iron. The operating valve is a ¾-in. straight-air valve, mounted conveniently and piped to the air cylinder as shown in the illustration.

Referring to the close-up view which shows this forming device in operation, details of the work-supporting table are quite clearly indicated. A flanged steel plate is bolted to either side of the V-block, these plates being made of ⅜-in. stock 8 in. wide. The plate at the right is provided with a ⅝-in. center slot, through which is applied a bolt for holding the stop plate, or length gage, in whatever position is desired.

With the use of this device, a true angle can be bent in cold steel bar stock up to ½-in. by 3-in., the number of pieces bent at one time depending, of course, upon their width, since the total width of the die is only 8 in.

Bacteria Control in Air-Conditioning Cars

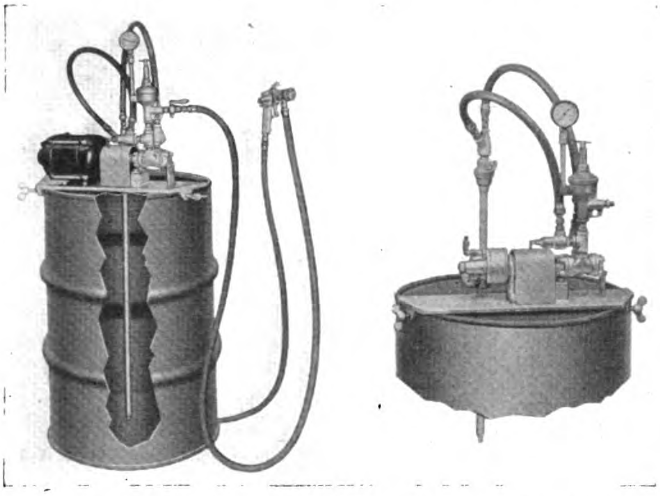
Extensive studies have indicated that bacteria control in air-conditioning systems is a protective measure that adds another valuable feature to the proved health and commercial advantages of air conditioning. In many types of air-conditioning systems, economy requires the re-use of the water employed for washing the filtered air before it is returned to the cars or rooms. It is a known fact that a considerable amount of organic matter from recirculated air is introduced into the recirculated wash-water, providing sufficient food material to allow

bacteria to grow and increase rapidly. Due to this, algae and slime growths accumulate on surfaces directly in contact with water, and thus interfere with the efficient operation of the system. In addition, surfaces of coils used for heating and cooling air also accumulate deposits and re-infect the washed air, so that air washed with water of high bacterial content or that contacts bacterial growths on surfaces, becomes a carrier of infectious organisms detrimental to health.

Oakite Products, Inc., through its Research Division, has developed a new material known as Oakite Airefiner that is said to solve this problem. When added to the recirculating water used to wash or scrub air, Oakite Airefiner keeps the wash-water sterile and prevents the growth of slime and algae deposits in the system. This material is said to be completely soluble, transmits no odor to water or air, and provides a stable, colorless solution that is safe and non-toxic. It is non-corrosive to metal surfaces, and helps prevent water scale formation. Reports on its use indicate that it is economical, only very small amounts being required to destroy bacteria and to keep water sterile.

Circulating Pump Attached To Shipping Container

The DeVilbiss Company, Toledo, Ohio, has announced a Type QB circulating pump for delivering clear varnish, clear lacquer and other non-pigmented finishing ma-



Left—DeVilbiss motor-driven circulating pump for varnish and lacquer attached directly to the shipping drum. Right—The application of an air motor to the pump

terial from the shipping container directly to the spray gun. It is the first equipment of its kind to be offered by this company and has been perfected after three years of experiments undertaken to eliminate the hazards of the old-type pressure equipment when used on old or weak drums. The pump draws material out of the drum and generates sufficient pressure in the pump head to feed the fluid to the spray gun at any correct predetermined pressure. The speed of operation is limited only by the operator's ability to handle the gun. Reports from plants where the unit has been installed indicate time savings of 25 per cent to 40 per cent over gravity or pressure drum methods. A consistently higher quality of work is said to be effected by the unvarying fluid pressure at the spray gun.

The unit is available with either electric-motor or air-motor drive, and consists of (1) a steel base plate on which is mounted the motor, pump, relief valve, and fluid regulator, and (2) a fluid suction and return assembly which can be inserted and interchanged in drums with ¾ in. or larger openings. The unit and hose can be cleaned each day after use. Protection against dirt or foreign substance getting into the finishing material is provided by an adjustable sliding collar on the tube entering the drum.

Harnischfeger Smootharc Welders

The Harnischfeger Corporation, Milwaukee, Wis., announces a line of simplified P. & H. Hansen Smootharc welders featuring single current control, self-excitation and internal stabilization, the qualities deemed necessary for fast, steady welding, deep penetration and uniform

Smootharc self-excited welder

metal deposit. This line of welders is built in two styles vertically mounted in 75-, 100- and 150-amp. capacities and horizontally mounted in 200-, 300-, 400- and 600-amp. sizes. Both models are compactly built without projecting parts to permit easy portability.

Single current control, the outstanding feature of the welders, is made possible by a patented design of shifting generator brushes. By means of a micrometer-screw shifting device an infinite number of current settings is secured and the voltage is maintained automatically at a high value. A turn of one controlling dial gives the desired welding current.

All Smootharc welders are self-excited by means of a set of auxiliary brushes placed ahead of the main brushes and connected to an auxiliary shunt winding. No extra

commutator is needed, thus saving weight, space and wearing parts. The generator is designed to permit the shifting of both main and auxiliary brushes, thereby making available the proper amount of excitation for each current setting.

Self-stabilization is secured in the welders through the use of interpole winding extended to the main pole shoes in such a manner that it serves the dual function of interpole winding and stabilizing winding. This causes less spatter loss because speedy arc recovery is secured through the combination of short-circuit winding and the magnetic bridge located in the main field magnetic circuit. A lower cost per pound of metal deposited is claimed for the unit.

The generator instruments are mounted in a single control panel built into the side of the streamlined motor housing. The construction is rolled-steel, arc-welded, and all steel parts, field ring, and pole shoes are annealed to give the highest possible quality magnetic field for generator fluxes.

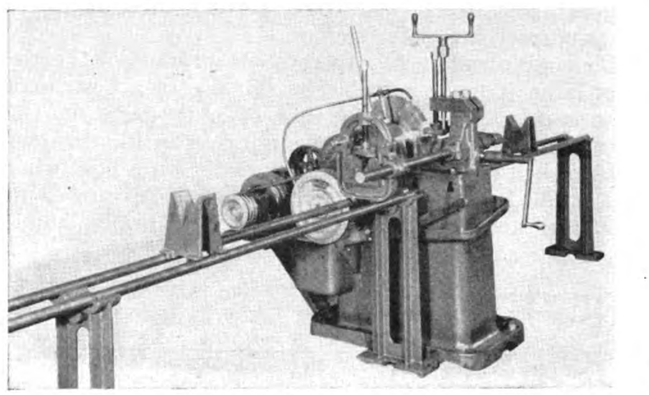
Air-Leak Testing Compound

An air-leak testing compound which meets with the A.A.R. specifications of being a soap has been developed by the Magnus Chemical Company, Garwood, N. J., to provide an extremely tough-skinned bubble with several times the size and visibility of a bubble made with an ordinary soap. Another feature is the fact that the air-leak testing solution made with the compound will not jell or stiffen on standing, but remains in the form of a viscous fluid which is simple to apply, and the results easy to observe. It will not harm metal, rubber or hands. It is not a new or untried material, except so far as widespread use is concerned. It has been supplied for over two years to one of the larger railroads, for which it was originally developed, and supplied likewise to a number of smaller roads.

The preparation, designated as the Magnus No. 51 air-leak testing compound is used in quantities of 2 or 4 oz. per gal. of either warm or cold water to make up a thick liquid soap solution which is painted over all connections as stipulated in A.A.R. specifications. Bubbles formed where any leaks occur will have several times the size and consequent visibility of those formed by any ordinary soap solution.

Rotary Saw for Small Bar Stock

The illustration shows a small circular saw arranged with support track and stock feed for cutting small round bars in multiple. The vise has capacity for holding eight 1⅛-in. round bars at one time; other sizes are held in proportion. The cut is made in 1½ min. The machine uses a 16-in. diameter inserted-tooth saw blade.



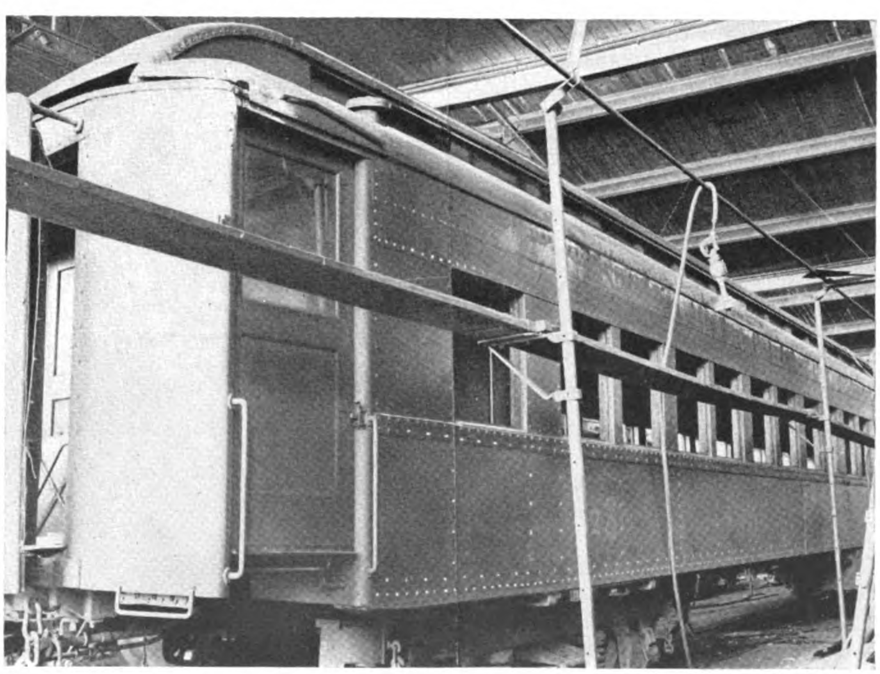
Cochrane-Bly saw for bar stock

The saw is driven by a 2-hp. 1,200-r.p.m. motor through multiple V belts protected by a welded steel guard. If desired the machine can be furnished with a three-screw vise for holding the pieces being cut off outside of the saw blade. It is provided with a lubricant pump with flexible tube and distributing nozzle over the saw blade. This machine can also be arranged for cutting single bars, and is provided with three changes of feed for hard and soft stock. It weighs about 1,600 lb. and occupies floor space 29 in. by 50 in. It is made by the Cochrane-Bly Company, Rochester, N. Y.

* * *

Coach Roof Repairs

Corrosion at the joint between the roof and letter board on this passenger car necessitated extensive repairs. The road, not desiring to rebuild the car and apply a new roof, made temporary repairs suitable for four or five years service as shown in the illustration. The roof sheets, all around the sides and ends of the car, were cut away for a width of about five inches and a patch sheet applied. The patch sheets were fastened to the side sheets, where through bolts could be used, by drilling and applying ¼-in. stove bolts spaced about 2½in. centers. The upper joint, to the roof sheets, was held in place by Parker-Kalon self-tapping screws. After fastening with the bolts and screws the joints, top and bottom, were welded, ground down to a smooth surface and refinished.

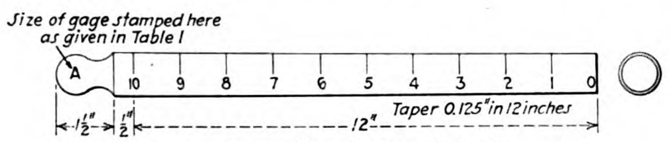


IN THE BACK SHOP AND ENGINEHOUSE

One Machine Produces 300 Tapered Bolts per Day

All tapered bolts for freight locomotive repairs at the West Albany shops of the New York Central System are made on a turret lathe, which has an average production of over 300 bolts per 8-hr. working day. This rather high production of bolts with one machine is facilitated by a principle of cutting-tool adjustment developed at these shops which permits machining the bolt to correct size with one cut.

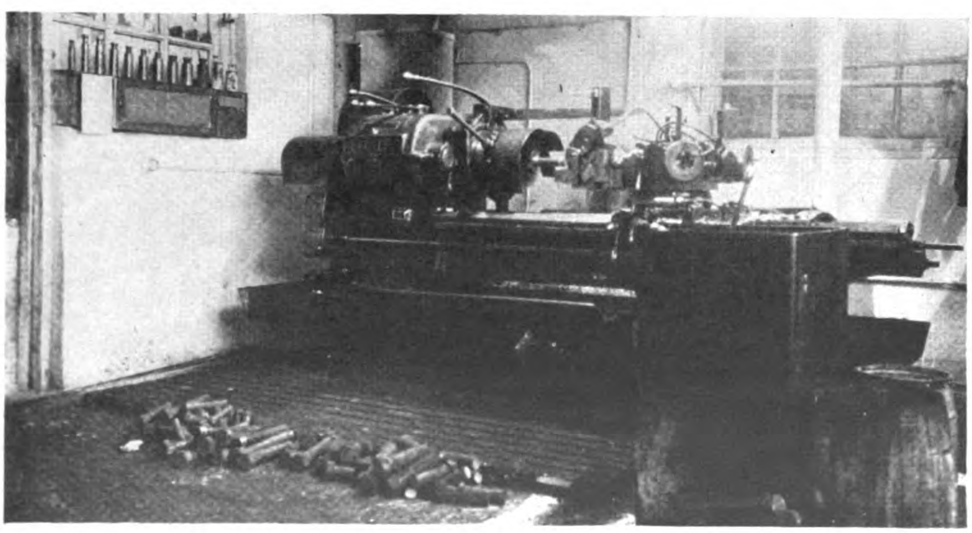
The concentration of tapered-bolt production at the turret lathe is made possible by the use of a system of measurements involving the use of plug gages in the erecting shop. The measurements taken in this manner are furnished to the turret-lathe operator on a bolt order form. The bolts are produced to these sizes and with a standard taper of $\frac{1}{16}$ in. to the foot. Naturally, standard tapered bolts could not be used unless clean, round holes of uniform taper are reamed in the locomotive parts for which the bolts are intended. To assure this, all $\frac{1}{16}$-in.-per-ft. tapered reamers used in the shop are kept in first-class condition and constantly checked by the tool-maintenance forces. A series of hardened tapered plug gages are used for obtaining the hole size. As shown in one of the illustrations these gages are 12 in. long tapered $\frac{1}{8}$ in. per foot and have ten graduations spaced 1.2 in. apart; thus, each plug gage can be used for obtaining hole sizes over a range of $\frac{1}{8}$ in. The range of gages used is shown in Table I. After the diameter at the large end of the hole is obtained by the plug gage, the body length of the bolt and the overall length of the bolt are measured. Rough bolts of the proper size are then delivered to the bolt-turning lathe accompanied by a requisition such as shown in Table II which shows the number of bolts required, the letter designation of the plug gage used, the graduation of the plug gage, the body length of the bolt and the total length of the bolt under the head. The bolts are turned on turret lathes equipped with a taper-turning head, a bell pointer, and four automatic die heads for threading bolts of different sizes. A taper bar and taper mechanism which produce absolutely a taper of $\frac{1}{16}$ in. in 12 in. are a part of the equipment.



Plug gage used for obtaining hole size

When the turret lathes were delivered to the shop it was the manufacturer's intention to have the operator take a roughing cut over the length of the bolt, measure the diameter under the head with a micrometer to determine its oversize, and then adjust the tool by dial setting to remove the necessary amount of stock to bring the bolt to the required size under the head. In other words, if the operator after taking a roughing cut found that the bolt was 0.010 in. oversize under the head, he adjusted the tool for the finish cut by setting the dial to 0.010 in. Although this method was an improvement over the making of tapered bolts on a small engine lathe, the supervision at West Albany was not satisfied with the production of the machine and, therefore, devised the method described in the following paragraphs for turning the bolts to finish size with one cut.

Assuming that only straight bolts of 2 in. diameter were to be turned on the turret lathes by unlocking the taper mechanism, it was observed that it would be a simple matter to make a plug gage of two diameters, the large end of which would fit exactly in the bore of the turning head and the small end of which, with a diameter of exactly 2 in., would extend past the cutting tool and rolls in this head. Such a plug was made and placed in the bore of the cutting head. Then, with the dial for adjusting the tool set at zero, the rolls and cutting tool were placed in contact with the 2-in. diameter extension of the gage. The tool and rolls were locked in this position and the gage removed. If a bolt were cut with the tool and rolls in this position and with the taper mechanism unlocked, the bolt would be straight throughout its entire length; it would have a diameter of exactly 2 in., and the finish size would be obtained with one cut. Furthermore, any diameter straight bolt within the limit of the head could then be machined to finish size in one cut by adjusting the dial for the required size. The next step was to adapt the plug method of setting the tool



The machine used for producing all the tapered bolts required for the freight-locomotive repairs

and rolls for turning tapered bolts. How this was done can best be exemplified by discussing all the factors involved in turning the bolts, remembering that the bolt-turning head is designed to cut either straight or tapered bolts and that the taper-cutting mechanism can be locked or unlocked by the movement of a lever.

Since the plug-gage system is used at the West Albany shops for obtaining the hole size, only the large diameter of the hole is obtained. This meant that some method had to be devised for adjusting the cutting tool and rolls to the small-end diameter of the bolt so that when the bolt was finished it would be the required size under the head. The next step was to determine the maximum length of bolt which had to be turned on the machine in order to limit the travel of the turret head to a minimum. For convenience in this article assume that the size bolt to be finished on the machines is 2 in. in diameter and has a body length of 12 in. with a taper of $\frac{1}{16}$ in. in the 12-in. length. With this taper, the diameter of the bolt at the small end will be $1\frac{15}{16}$ in. and, when the cutting tool is at this point, the indicating finger on the taper bar is at the 12-in. mark. A plug of two diameters is then made, the large end of which would fit exactly in the bar of the turning head and the small end of which, with a diameter of $1\frac{15}{16}$ in. plus 0.0025 in., would extend past the tool and rolls in this cutting head. The additional 0.0025 in. is added to the small-end diameter of the bolt so that the finish size under the head will be 0.0025 in. oversize for drive fit.

Table I—Plug Gage Classification and Limits

Gage No.	A	B	C	D	E	F	G	H	I	J	K	L
	Gage Limits											
10	1.1250	1.2500	1.3750	1.5000	1.6250	1.7500	1.8750	2.0000	2.1250	2.2500	2.3750	2.5000
9	1.1125	1.2375	1.3625	1.4875	1.6125	1.7375	1.8625	1.9875	2.1125	2.2375	2.3625	2.4875
8	1.1000	1.2250	1.3500	1.4750	1.6000	1.7250	1.8500	1.9750	2.1000	2.2250	2.3500	2.4750
7	1.0875	1.2125	1.3375	1.4625	1.5875	1.7125	1.8375	1.9625	2.0875	2.2125	2.3375	2.4625
6	1.0750	1.2000	1.3250	1.4500	1.5750	1.7000	1.8250	1.9500	2.0750	2.2000	2.3250	2.4500
5	1.0625	1.1875	1.3125	1.4375	1.5625	1.6875	1.8125	1.9375	2.0625	2.1875	2.3125	2.4375
4	1.0500	1.1750	1.3000	1.4250	1.5500	1.6750	1.8000	1.9250	2.0500	2.1750	2.3000	2.4250
3	1.0375	1.1625	1.2875	1.4125	1.5375	1.6625	1.7875	1.9125	2.0375	2.1625	2.2875	2.4125
2	1.0250	1.1500	1.2750	1.4000	1.5250	1.6500	1.7750	1.9000	2.0250	2.1500	2.2750	2.4000
1	1.0125	1.1375	1.2625	1.3875	1.5125	1.6375	1.7625	1.8875	2.0125	2.1375	2.2625	2.3875
0	1.0000	1.1250	1.2500	1.3750	1.1500	1.6250	1.7500	1.8750	2.0000	2.1250	2.2500	2.3750

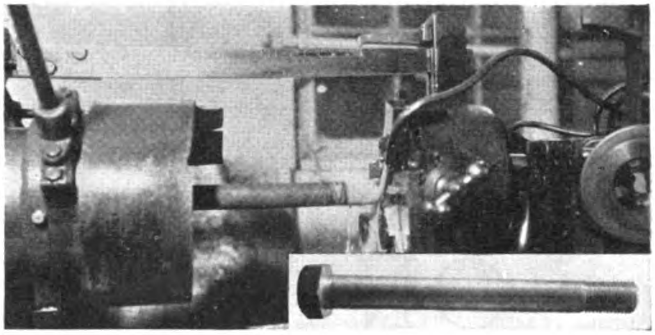
The two-diameter plug is set in the cutting head and, with the tool-adjusting dial set at zero, the tool and rolls are brought in contact with the small end. The tool and rolls are then locked in this position and the plug gage is removed. The turret head is then moved forward until the indicating finger on the taper bar stops at the 12-in. mark. When the taper-turning mechanism is locked and when the turret head is located with the indicating finger on the taper bar set at the 12-in. mark, the machine is ready to turn a taper bolt 2.0025 in. in diameter under the head.

A rough bolt 14 in. long is chucked and pointed with a bell pointer, and the tool in the cutting head is set with the adjusting dial at zero. The cutting head is brought into contact with the bolt and the feed is engaged. For a 2-in. length the bolt will be cut straight with a diameter of $1\frac{15}{16}$ in. plus 0.0025 in. When the indicating finger on the taper bar reaches the 12-in. mark the taper cut is started and the bolt from that point on will have a taper of $\frac{1}{16}$ in. in a foot so that the diameter under the head will be 2.0025 in.

No. Bolts	Plug	Gage	Body Length, in.	Bolt Length, in.
1	C	7	$11\frac{1}{2}$	$13\frac{1}{2}$
3	D	$5\frac{1}{2}$	$3\frac{3}{4}$	6
3	D	$5\frac{1}{2}$	2	4
6	D	4	$4\frac{1}{4}$	$6\frac{1}{4}$
7	D	4	$1\frac{3}{4}$	$3\frac{3}{4}$
2	A	9	$1\frac{1}{4}$	$3\frac{1}{4}$
1	C	4	$1\frac{1}{2}$	$3\frac{1}{2}$
4	B	$4\frac{3}{4}$	$7\frac{1}{4}$	9

Name ____________________ Engine No. ____________________

Sample requisition of bolt order received by the machine operator



Turning a 2-in. by 12-in. tapered bolt to size in one cut—The finished bolt was completely machined in 1 min. 23 sec.

After the tool and rollers in the cutting head are thus set, any other bolt with a diameter of 2 in. or less and with a body length of 12 in. or less can be turned. Assume that a $1\frac{3}{4}$-in. bolt, 12 in. long, is to be turned. The tool-adjusting dial, therefore, must be turned in 0.25 in. The bolt is placed in the chuck, pointed and the turret head indexed to its cutting position. The turret head is brought forward to contact the bolt and the feed is engaged. The thread end of the bolt will be turned straight to a diameter of $1\frac{11}{16}$ in. to a length determined by the number of nuts to be used. When the indicating finger on the taper bar reaches the 12-in. mark the taper feed becomes effective and the finish size of the bolt is turned in one cut, the diameter under the head at the end of the gage being $1\frac{3}{4}$ in. plus 0.0025 (1.7525 in.) under the head. Practice has proved that the taper at the end of short bolts can be disregarded when cutting threads.

One of the illustrations shows a bolt $1\frac{1}{4}$ in. in diameter and 12 in. long being turned; it also shows the finished bolt. This bolt was obtained from a rough-stock bin, set in the lathe, finished and removed from the lathe in 1 min. 23 sec. The outstanding feature of machining tapered bolts for locomotive repairs is the fact that only one turret lathe, shown in one of the illustrations, is used in the freight-locomotive erecting shop for turning all the bolts required. As previously stated, this lathe produces an average of 300 finished bolts every 8-hr. working day.

After the plug principle for adjusting and cutting tools and rolls was developed at the West Albany shops the manufacturer of the machine adopted the plugs as standard equipment and is furnishing it to all purchasers of the lathe.

A VACATION ON NIGHTS . .

by Walt Wyre

"How's the 5080 coming?" John L. Starkey, general foreman for the S. P. & W. at Plainville, asked.

"Quite a bit of work yet," Jim Evans, the roundhouse foreman, replied. "Looks like we might have to work a couple of machinists and helpers overtime to finish it."

"Hell, no!" Starkey snapped. "Let's not work any overtime unless it's absolutely necessary. I've been burnt so much lately about overtime that my south end feels like a piece of toast before it's been scraped."

"Going to need her tonight," Evans reminded.

"Put all the men on her you can spare and leave her for the night men to finish," Starkey said.

"O.K.," Evans replied, "but the night foreman has got his hands full without us leaving him a lot of extra work."

"The night job's not bad, just inconvenient having to sleep days. The job itself is a pension. Of course, to hear Parker tell it, his shirt tail never has a chance to get acquainted with his back, but he's not kidding me. Why, he's only got about a dozen men on nights and they don't have much to do."

"Parker wants off next week. Why don't you go on the job while he's off?" Evans suggested. "It would give you a chance to rest up a bit." Starkey missed the tinge of sarcasm in Evans' tone.

"Well, if you don't mind taking care of the day job alone for a week, I might do it," Starkey replied.

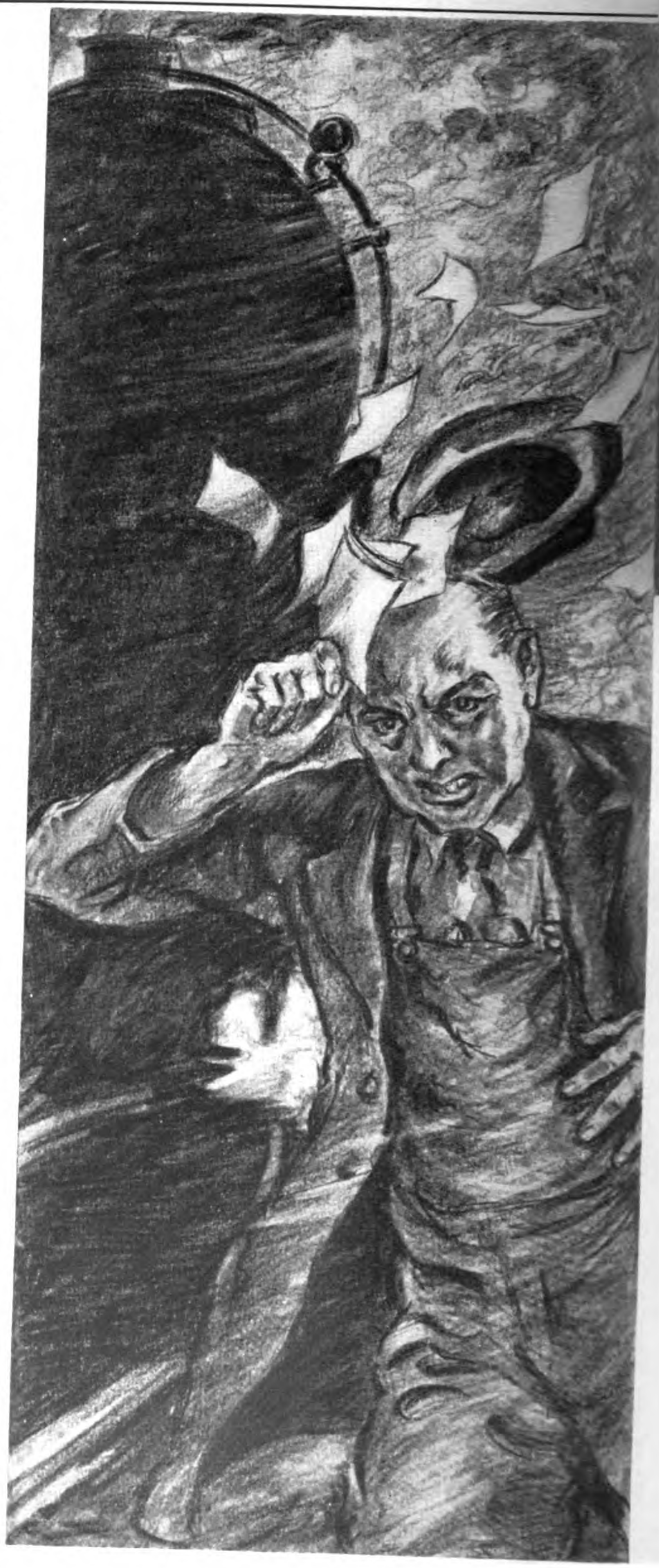
Starkey stayed at home the afternoon that he was to go on nights.

Evans made a special effort to see that all work possible was done by the day force. Having handled the night job himself, he knew that it was no swivel chair job and that Starkey would have trouble enough, at best.

About 6:30 that evening Evans went to the roundhouse for a final look for the day. The foreman noticed a low-lying bank of clouds crouching against the horizon in the northwest as though waiting for darkness to spring. A purplish blue haze hung like a diaphanous curtain over the bank of clouds. Evans noticed, too, that the wind had shifted and the air was noticeably colder. "Looks like it might come a whizzer before morning," Evans commented to himself.

"How's everything going?" Starkey asked when he entered the roundhouse office a few minutes before seven.

"Oh, not so bad," Evans replied. "Everything's in fair shape. If that northwester hits, as it looks like it will, the despatcher will probably want to double-head the Limited; maybe No. 9, too. If he does, you'll be a



The northwester pounced with a roar. Starkey felt his hat leaving his head and made a grab. When he did, his fingers loosened on the work slips

Foot braced against the hand rail, Starkey opened the door of the dynamo and played the beam of his flashlight over the armature and brushes

little short of power. Everything's in the dope book," Evans added as he started to leave.

Starkey sat down at the desk to look over the lineup and read the dope book. The night roundhouse clerk didn't come on until eight.

"B-r-r-r!" The telephone sounded loud in the quiet office.

"Hello . . . Yes . . . When do you get out? . . . . Wait until I look at the board."

It was a fireman wanting to know what time he was likely to get out. Starkey looked at the board, then picked up the telephone.

"You're four times out, but don't know just what time it'll be. Call later when the clerk's here," the foreman told the fireman and again started to read the lineup. He had finished the first two lines when the phone rang again.

"Hello . . . Yes, this is the roundhouse office. . . . No, Mrs. Jones, I can't say whether your husband will be in before eleven o'clock or not. Call back after eight o'clock. The clerk will be here then." Starkey slapped the receiver on the hook and picked up the dope book.

"I need two ⅞ hex nuts." The speaker was Morrison, a machinist, that started to work at six o'clock.

"Haven't they got any in the storeroom?"—then Starkey remembered there wouldn't be any one in the storeroom until eight o'clock. The night foreman carried the key and handled material from seven until eight in the evening and from five until seven in the morning.

Starkey searched in the desk drawer until he found the key. "Here, go get them and bring the key back," he told the machinist.

The phone rang three times more in the next ten minutes—an engineer wanted to lay off, the hoghead had probably noticed the clouds in the northwest; a fireman was going to the picture show, in case he was wanted; a fireman's wife wanted to leave word that she would be at a neighbor's if she wasn't at home when her husband called. Starkey became disgusted and took the receiver off the hook and left it off.

The foreman looked over the lineup, read the dope book, and went to the roundhouse. He had made the rounds and was starting back to the office when he met a messenger.

"The despatcher said tell you that your phone is not working and he wants a 2700 for a stock train east at 10:30," the messenger said.

"Tell him it'll be the— No, I'll call him back."

"But your telephone ain't working," the messenger said.

"Well—er—if we don't get it working, I'll send somebody to tell him," Starkey told the messenger.

The foreman rushed to the office and placed the receiver back on the hook. After checking over the engines that were O.K., he waited a few moments then called the dispatcher and gave him the 2714 for the stock train.

The night clerk came in just as Starkey finished talking to the despatcher. The foreman glanced at his watch, five minutes until eight. "Great Scott!" he groaned, "the work slips were not even sorted." He grabbed the work reports and slips and rushed out of the office.

The northwester pounced with a roar. Starkey felt his hat leaving his head and made a grab. When he did, his fingers loosened on the work slips. A dozen or more of the yellow slips whisked away in the darkness. Starkey grabbed at the slips. His hat followed the slips. The foreman ran a few steps in pursuit and gave up. Paavo Nurmi himself couldn't have kept pace with the flying hat.

The bellow of the eight o'clock whistle blended with the howl of the wind. Starkey went back to the office holding fast to the crumpled work reports and remaining slips. "Wish you'd look these over and make new ones for the ones I lost," he told the clerk.

While the clerk was copying the reports on the work slips, Starkey found a cap and put on an additional jumper and started back to the roundhouse.

The night force were standing around the board waiting to go to work when the foreman got there. He assigned each of the five machinists to look an engine over and start working it. The boilermaker, he told to look over the engines that were marked up to run and do what was necessary to get them in condition to go. Boiler washers and cellar packers had already begun on their jobs. They knew from experience that it would keep them humping eight hours to get over the required number of engines.

When the men were all lined up and working, Starkey went back to the roundhouse office. The clerk had copied the work reports and had the slips ready to be distributed. That meant another trip to the roundhouse. Starkey picked up the yellow slips and again headed into the howling wind that had reached the proportions of a healthy young hurricane.

"Got to have a middle connection bushing for the

5088." Barnes, a machinist, hastily told the foreman.

"Well, go ahead and make it," the foreman replied.

"But—" The machinist didn't get a chance to finish. Starkey was already leaving.

The nut-splitter stood glaring at the foreman's back until Starkey disappeared around the front of the 2746 three stalls away. Then Barnes walked hesitatingly towards the machine shop.

Starkey distributed the slips hoping he had given the various mechanics jobs they could do best and started back to the office. The foreman didn't get far before a machinist stopped him. The machinist was holding a copper pipe in his hand.

"Have to have a collar brazed on this pipe."

"Give it to a coppersmith," Starkey replied and started to walk on.

"Ain't no coppersmith on nights," the machinist replied.

"Guess you'll have to braze it yourself then," Starkey said.

"I'll try it if you say to, but—"

"Go ahead and braze it," the foreman told him and went on to the office.

"Despatcher wants to know if he can count on getting the engine for the stock extra at 9:40 and he wants another one at 10:15. He wants a 5000 this time," the clerk said.

The foreman hesitated a moment, then said, "Tell him it'll be the 5088. Guess I'd better go see if the firebuilder has got a fire in her yet. Ought to have roller skates on this job," he remarked as he reached for the door knob.

The fire-builder had a fire going in the 5088 and the hand on the steam gauge had already left the peg. The middle connection bushing was yet to be replaced, the foreman remembered, but machinist Barnes was working on that.

He climbed down from the cab and started to go to the machine shop to see how Barnes was getting along with the bushing when the second trick inspector came rushing up as though he had just discovered a fire and was on his way to give the alarm.

"No lights on the 2714!" the inspector panted.

"Where is she?" the foreman asked.

"Outside," the inspector replied. "The hostler is taking her around."

"Well, get the—" Starkey started to say get the electrician, then remembered there was no electrician on nights. "Who does the headlight work at night?"

"Oh, first one then the other. If it's much of a job, Parker calls the electrician. He usually does the little jobs himself."

"Well," Starkey said resignedly, "I'll go look at it. You got any tools with you?"

"Pair of pliers and a hammer," the inspector said.

Although it was only a few minutes after nine o'clock, Starkey's legs groaned in protest as he and the inspector hurried toward the 2714.

In the meantime, the northwester had quit fooling and gone to work in earnest. A blast of sand mixed with snow and sleet rode the icy wind.

"Blowing pretty hard?" Starkey yelled as he wiped the tears from his smarting sand-filled eyes.

"Ugh-huh," the inspector replied, keeping his mouth closed against the sand.

By the time the pair had reached the 2714, Starkey was pretty well played out. The foreman climbed up in the cab and sat down on the fireman's seat box to get his breath and wipe some of the sand from his eyes.

"O.K.," the hostler helper yelled from the top of the oil tank where he was filling the tank with fuel oil.

"How much time we got?" Starkey asked the hostler.

"'Bout forty minutes," the hostler replied as he released the air and eased the throttle open a few notches. "Got to take water, then I'll set her out on the lead."

"I'll take a look at the dynamo while you're taking water," Starkey told the hostler when the engine was spotted at the water crane.

Starkey, flashlight in hand, climbed out on top of the locomotive. The wind howled a protest and showered the foreman with a stinging blast of sand.

Foot braced against the hand rail, Starkey opened the door of the dynamo and played the beam of his flashlight over the armature and brushes. The brushes were still there and the armature was turning. The dynamo looked O.K., but the lights wouldn't burn.

"Look out—I'm going to move her," the hostler yelled and gave two short toots of the whistle.

"Go ahead," the foreman yelled back and braced himself more firmly.

"Whoosh!" the exhaust gurled as the engine vomited a slug of water from the stack. It wasn't Saturday night, but Starkey got a bath. The wind was blowing in just the right direction to hurl the spray of water toward the foreman. "Hey!" he yelled.

The hostler stopped the engine but not before another deluge of water from the stack had finished wetting the foreman's back. He climbed down in the cab and backed up to the fire-door.

"What's the idea, filling the boiler so full of water it spouts like Old Faithful?" Starkey asked the hostler.

"I'll blow her off some," the hostler was trying hard to keep from laughing, "and I always leave it fairly well filled," the hostler added as he released the air.

When the engine had stopped on the lead to wait for the crew, the foreman again climbed out on the boiler. In three minutes he was cold as a bottle of frozen beer. A film of ice was beginning to form on his overall jumper and he had made no progress in locating what ailed the recalcitrant dynamo.

He was about ready to give it up when the clerk came out in search of the foreman. The clerk yelled at the top of his voice but couldn't make himself heard above the roar of the wind. Starkey climbed stiffly down to see what the clerk wanted.

"Despatcher wants to double-head the Special and No. 9, and he said be sure the engine was ready for the second stock train."

"G-go c-call the electrician, t-tell him to h-h-hurry." The foreman's teeth were chattering. When in the office, he peeled off the wet jumper and found a dry one. He put his overcoat on over the jumper and urged himself towards the roundhouse.

Starkey stopped at the 5088. The middle connection bushing had not been renewed and the machinist doing the job was not in sight.

"Where's Barnes?" the foreman asked the cellar packer.

"Out in the machine shop, I think," the cellar packer replied.

Starkey headed for the machine shop. The machinist was taking a cut on a brass. At least that seemed his intensions. The lathe tool evidently had other ideas from the way it was acting.

"What's the matter, Barnes? Haven't you finished that bushing yet?"

"Er-ah-I made one and got it too big on the inside. This brass is full of sand spots and I'm having trouble with the tool," the machinist replied.

"My God, man, it oughtn't to take two hours to make a bushing!"

The machinist flushed a dull red. "Well, you see, I took a lot of time finding lathe tools. I haven't got any myself," the machinist explained. "And it's been several years since I did any lathe work."

"Who does the machine work nights?" Starkey asked.

"Holmes does most of it. He's got the tools."

"Well, where in the hell is Holmes?" the foreman exploded.

"Last time I saw him he was trying to braze a collar on a copper pipe and having a dickens of a time doing it, too. I most generally do the cab work and brazing," he added.

"Why in the hell didn't you tell me! Find Holmes and tell him to make the bushing and hurry!"

Starkey on his way through the roundhouse saw Holmes before Barnes did. Holmes had the same piece of copper pipe in his hand that he was carrying when the foreman had first told the machinist to braze it himself.

"Well, I'll be damned!" the foreman exploded when he saw the job of brazing on the pipe. "Have you been working on that all this time?"

"Yeah, I ain't much of a coppersmith," Holmes growled.

"Well, beat it to the machine shop and see what you can do with that bushing that Barnes has been working on. Let him finish the pipe." The foreman went on down through the house.

Near the board he met the night boilermaker. "Washout plug leaking in the 5071," the boilermaker said.

Starkey looked at his watch. "And she's called for the Limited. Can't you tighten the plug so it won't leak?" It was more of a plea than a question.

"Not a chance. I tried it," the boilermaker said.

"Let's look at it," the foreman said, in the tone he might have used when speaking of looking at the corpse of a close friend that had died suddenly.

The plug was leaking, and it was tight—no argument on either point. While they were examining the plug, the hostler came in to take the engine out.

"Ready to go?" the hostler inquired.

"Not quite," Starkey replied. Then to the boilermaker he said, "Get a chisel and calk the plug. I know it's bad business, but it's that or delay the Limited. I'll take the chance."

When quitting time came, Starkey was too tired even to notice that the wind had stopped blowing. He walked as though he was wearing lead soled shoes like divers wear and his back end dragging out his tracks. He barely exchanged greetings with Evans when the day foreman showed up.

Starkey still showed the effects of his strenuous night when he returned to work that evening. A red hot wire from the master mechanic asking for explanations as to why a wash out plug had been calked and same found by a government inspector. That day didn't add to the gayety of the occasion. Starkey was mentally and physically tired but not whipped. When Evans, noticing the tired lines on Starkey's face, offered to work a couple more hours, Starkey refused the offer.

The next six nights were not as bad as the first one had been, but they were bad enough. Starkey was busy all night every night of the week. Instead of the vacation he had mentioned, he did seven nights of the hardest work he had done in many months. He had never dreamed that the night foreman had so many problems with which to contend and so much work for the number of men on the night shift.

"Well, how'd you like it on nights?" Evans asked when the general foreman was back on days.

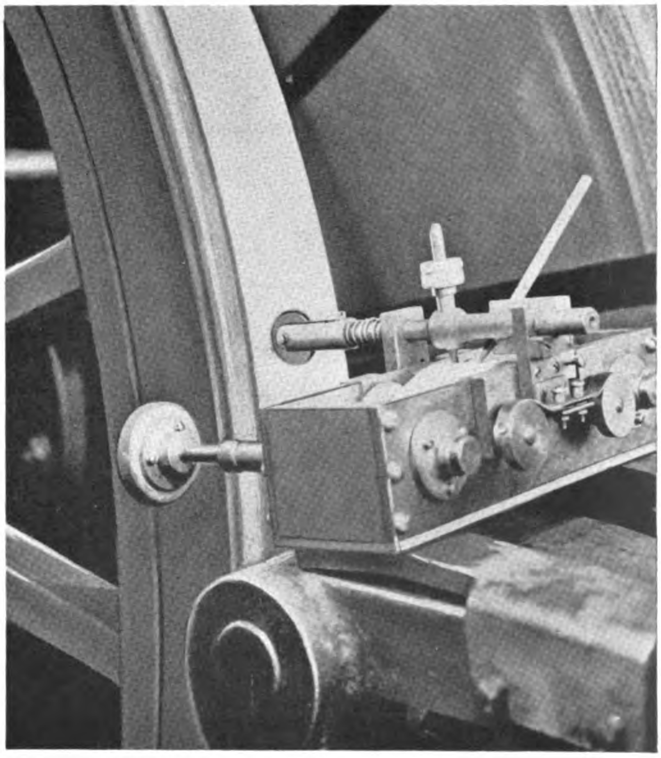
"Oh, it's not so bad after a fellow gets used to it. But I do think we need a coppersmith and an electrician and maybe another machinist and helper on nights," Starkey admitted. "More work on nights than I thought," he added.

Device for Recording Eccentricity of Wheels

A simple and effective device for producing a permanent record of the rotundity of driving wheel tires has been developed at the locomotive repair shop of the New York, Ontario & Western at Middletown, N. Y. The construction and method of using this recorder is clearly shown in the two accompanying illustrations, one of which shows the interior construction and the other the method of applying it to the tool post of the tire turning lathe.

The recorder consists of two gear-driven drums which carry a paper tape about two inches wide. The movement of the tape is effected by means of a roller, on an extended shaft, which bears against the inside of the driver tire. The tape is kept taut by means of a spring-steel brake acting on two small drums on shaft extensions at the rear of the casing.

The record on the tape is made by two pencils. One of these is fixed in a holder which is attached to the recorder casing and, as the tape moves, it draws a straight base line. This pencil is the one shown at an angle in the illustrations. The other pencil is the one which produces the record of the tire contour. This pencil is mounted vertically in a rod which moves toward or away from

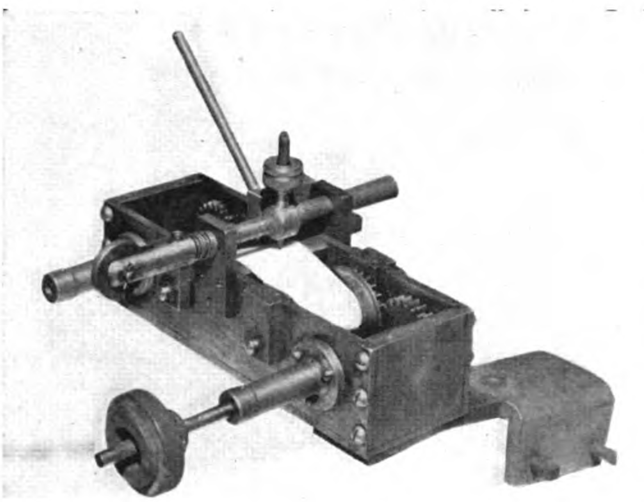


The indicator in position on a driving-wheel-lathe tool post—The movable roller and pencil produce the record of rotundity

the wheel center as the wheel turns in the lathe. A roller, in the end of this rod, bears against the tread and a coil spring, clearly shown back of the roller, holds it against the tire tread.

The completed record consists of two pencil lines on

the tape. One is a base line and the other, made by the pencil in the moving rod, indicates whether or not the tire is out of round, where, and how much. A perfectly circular tire tread, concentric with the axle would produe two straight lines on the tape. The distance that the lines would be apart would depend on the setting of



The roller in the foreground drives the recorder tape drums through gears—The indicator may be used on either right or left-hand tool post

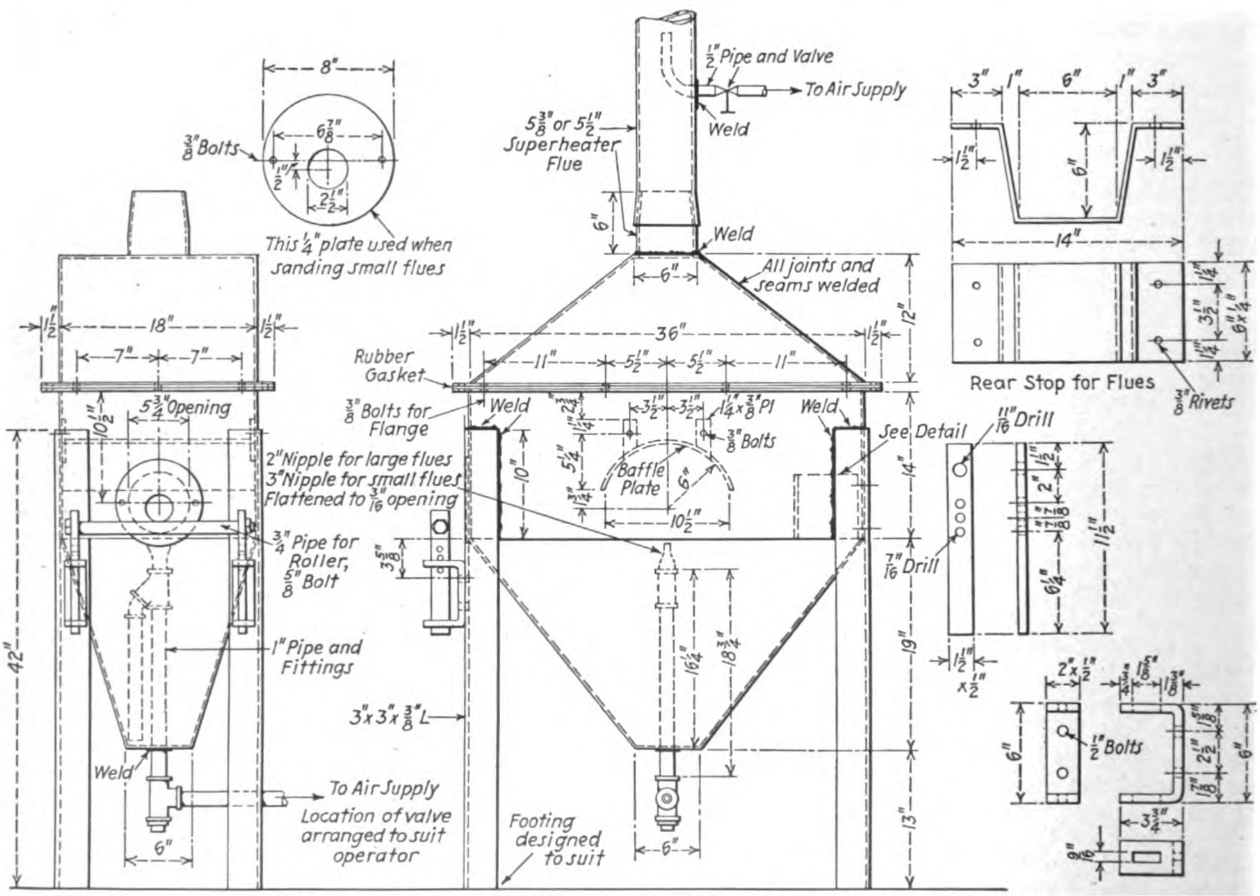
the recorder on the tool post. If, for example, it was set so that the lines were normally ¼ in. apart and the recording pencil made a line $\frac{5}{16}$ in. away from the base line at some point on the circumference of the tire, that would indicate that the tire was $\frac{1}{16}$ in. out of round at that particular location.

Flue-Sanding Device

The flue-sanding device, shown on the drawing, has been developed and successfully used at the Indiana Harbor Belt shops, Gibson, Ind., effecting a saving of 50 per cent and more in cost over the old method of grinding the exterior surface of flue ends so that they will make a good contact in the copper jaws of the electric butt-welding machine. The old grinding price was 1.5 cents per flue end which may be compared with 0.75 cents per flue end with the new sanding method. In the case of safe ends, a still greater saving is effected, the old price being 1.2 cents per safe end and the new price 0.4 cents per safe end. Average saving per locomotive is $3.56.

Experience shows that the average amount of sand needed to clean 100 flues and safe ends is 144 lb. The average cost of this sand, which includes handling and drying, is 22 cents per 100 lb. Strictly speaking the cost of the sand is less than this because, to a large extent, it consists of sand taken from the sand domes of locomotives due for shopping, which might otherwise be wasted. Also this sand is used over and over again.

Both the general arrangement and important details of this efficient flue-sanding device are clearly shown in the drawing. The main sand-box housing, made of sheet steel, 36 in. long by 18 in. wide by 40 in. high, is mounted 32 in. above the shop floor on four 3-in. angle iron legs applied to the corners of the box by welding. A taper hopper, welded to the bottom of this sand box serves for sand storage and to collect the heavier particles of sand which fall after striking the flue surface. The bottom of this hopper consists of a 6-in. square plate through which the 1-in. air line pipe passes to the sand nozzle and syphon connection. Above the sand



Flue-sanding device developed and used at the Indiana Harbor Belt Shops, Gibson, Ind.

box is a tapered hood which serves to collect fine dust particles in the air and conduct them into the exhaust pipe, made of a scrap superheater flue, which passes straight up through the shop roof.

The draft in this exhaust flue may be regulated as required by means of compressed air supplied through a ½-in. pipe which passes through the flue and is bent upward as shown in the drawing. While the entire structure of the flue sander is generally formed by welding, the dust-collecting hood is removable for purposes of inspection and repair of interior parts by simply taking out a few ⅜-in. bolts through the flanges. A rubber gasket is used to make this joint air-tight during operation of the sanding. Referring to the drawing, it will be noted that a circular baffle plate is located immediately above the flue position so that sand and air will not be blown directly out of the stack but be deflected downward and give a chance for the heavier particles of sand to drop back into the hopper.

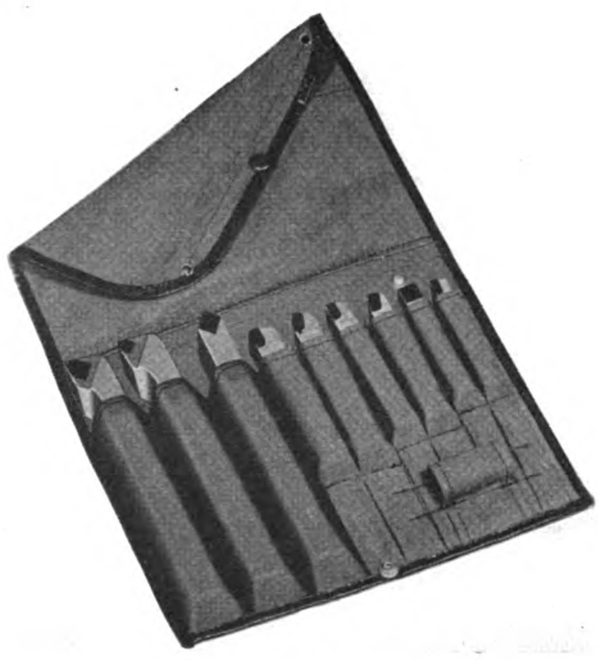
The detail construction of the sand nozzle is clearly shown. Air at shop pressure is brought into this machine through the 6-in. square bottom hopper plate and passes through a vertical section of 1 in. pipe to a special nozzle which consists of a 1-in. nipple flattened to a 3/16-in opening. This nipple is 2 in. long for large flues and 3 in. long for small flues. A Y-fitting with suitable pipe connection to the bottom of the hopper furnishes a supply of sand under syphon action, this sand being drawn into the air stream and forced at high velocity through the nozzle against the boiler flue. For durability the tip of the nozzle is coated with Stellite.

In operation, the flue end is pushed into this sanding machine through a close-fitting hole in the front of the sander and rotated as the end is gradually pushed through the sand stream until it hits a rear stop, suitably located. For small flues, a special circular plate with a 2½-in. center hole, as shown, is used. The weight of the flue is supported on a ¾-in. roller pipe, easily adjustable for height, as illustrated. Short safe ends are sanded by placing them, one at a time on a scrap flue which has been swedged down at one end and equipped with steel spring strips lightly welded to the swedged end and arranged to grip the safe end when it is slipped over them. The safe end, as thus applied on the end of the scrap flue is then sanded just like any long flue.

Carboloy Tool Kit

A Carboloy tool kit for general machining operations has been developed by Carboloy Company, Inc., Detroit, Mich. The kit contains nine Carboloy milled and brazed tools, a 20-page booklet dealing with rapid grinding technique, and a 12-page booklet showing more than 50 suggested applications for the nine Carboloy tools. The kit is adapted for shops where the limited production of any one type of part does not, in many instances, warrant the purchase of single-purpose carbide tools. To meet the requirements of such shops, the nine Carboloy tools in the kit are designed for general turning, facing and boring operations on engine lathes, turret lathes, boring mills and boring bars.

Of particular interest is the fact that the Carboloy tools in this kit are being furnished to the user in the so-called "milled and brazed" state. This carbide tool terminology means that all operations have been completed except the grinding. This is done by the user in his own plant using the technique described in detail in the grinding manual



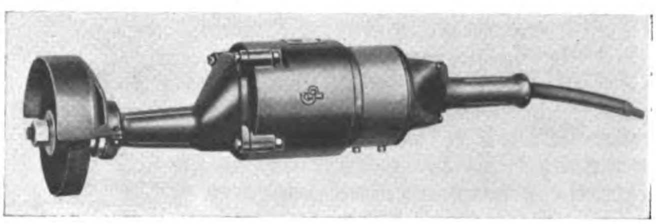
Carboloy tool kit for limit production jobs

enclosed with each kit. By this method, the user obtains the tools in the Carboloy kit at a saving of approximately 36 per cent in investment cost over the cost of these same tools in the finished ground state. However, a certain percentage of this saving is absorbed by the user when grinding the tools for use in his plant.

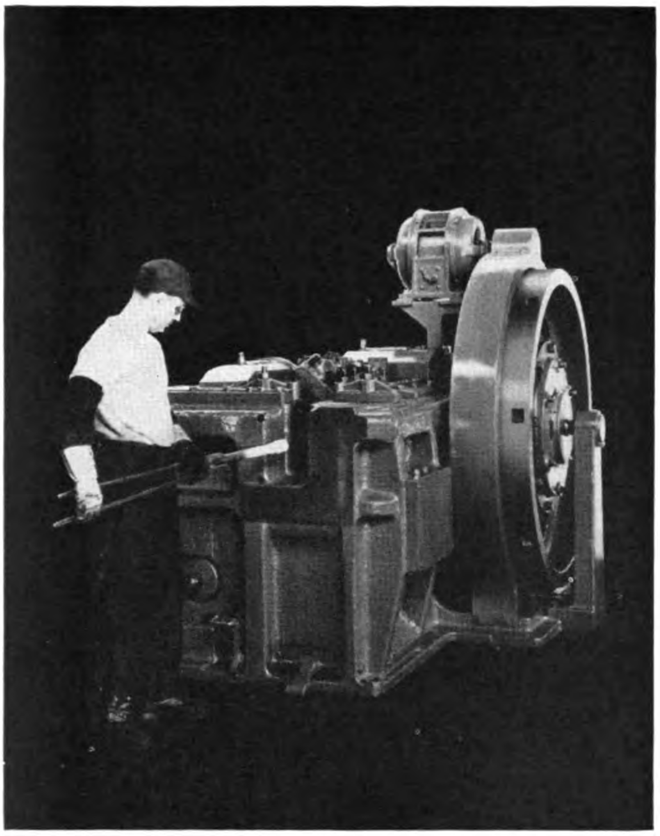
Universal Electric Grinder

The illustration shows an electric grinder which has been added to the products manufactured by the Chicago Pneumatic Tool Company, 6 East Forty-fourth street, New York. Although the tool is for general purpose grinding it can, with the proper wheel adjustment, be used for wire brushing, buffing, and polishing of all types of metal surfaces. The motor is totally enclosed and fan-cooled to eliminate dust troubles and over-heating. The motor is enclosed in a copper shield which conducts the motor heat to the cooling area. The fan forces a current of air over this shield and out over the gear case onto work.

The grinder is made in two sizes, one with a 5-in. by ¾-in. wheel and the other with a 6-in. by 1-in. wheel. The former weighs 13¾ lb. has an overall length of 23¾ in., operates free at 4,500 r.p.m. and loaded at 2,700 r.p.m. The 6-in. by 1-in. grinder weighs 22 lb., and has an overall length of 24 in. It operates at 3,900 r.p.m. when free and 2,600 r.p.m. when loaded. The work ends of the spindles of both grinders are equipped with two rows of ball bearings to take all radial and thrust loads.



Chicago Pneumatic electric grinder



The Ajax 1½-in. bolt heading and upsetting forging machine

Bolt Heading and Upsetting Forging Machine

The Ajax Manufacturing Company, Cleveland, Ohio, recently announced that its latest design of bolt heading and upsetting forging machine is being built in sizes rated at 1 in. and 1½ in. capacity and is being equipped with the patented Ajax air clutch, which has proved successful on larger machines. The 1 in. and 1½ in. machines occupy less floor space than earlier models, and give a higher production on a wide variety of intricate upset forgings, as well as a complete range of nuts, bolts and rivets.

Because of the capacity and speed of the machines, the flywheel is mounted on the crankshaft, and delivers ample power to drive the machine. The motor is direct connected to the flywheel, either through a fiber pinion on the motor shaft, which meshes with an integral gear on the flywheel rim, or through multiple V belts. It is mounted on a bracket above the crankshaft housing where it requires no additional floor space.

Instantaneous treadle response of the air clutch has increased production, decreased fatigue of the operator, and makes possible the completion in a single heat of forgings which formerly required a reheat after preliminary upsetting. When the foot pedal at the operator's position is depressed, it releases the band brake, and at the same time opens the air valve to the clucth. This introduces compressed air behind an air piston. carried by the flywheel, and applies pressure directly to the friction plates, clamping them together and starting the machine. At a predetermined point in the operating cycle, the air is cut off, disengaging the clutch. A cam on the rim of the brake drum then set the brakes, which stops the machine accurately on open stroke.

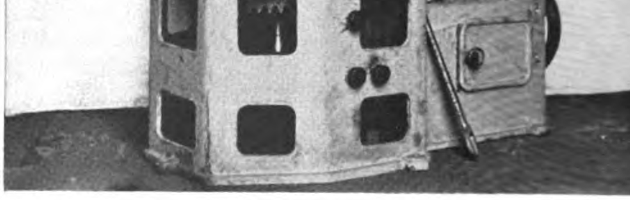
The bed frame is a one-piece open-hearth steel casting with deep vertical and heavy horizontal ribbing to withstand the tremendous heading and gripping pressures. Integral bearing housings bridged with a heavy horizontal crown rib support the forged alloy crankshaft which rotates in solid sleeve-type bearings. The header slide, which is top suspended from long wide lips, is held in alinement by an extension guide bearing supported at a neutral position in the frame. An intermediate under-arm holds the main slide body and the extended guide bearing in line, and prevents deflection under heavy loads. Due to the use of this patented slide construction—exclusive in Ajax machines—the entire pitman assembly is accessible for inspection or adjustment. The right-hand side liner of the header slide is screw plug adjusted to compensate for out-of-parallel wear unavoidably developed after long periods of service.

A fully automatic safety mechanism protects the machine from damage due to oversized or misplaced stock which would prevent the dies from closing. It immediately resets itself so that production is not interrupted by a shut-down which would necessitate removing the heated stock from the furnace. An adjustable double-plunger pump, built into an oil reservoir at the back of the machine, is driven off the crankshaft by a rachet arm. The pump delivers the lubricant at a predetermined rate into the two distributors or headers, where it is proportioned into pipes that carry it to the oil pocket at each bearing.

Schatz-Herkules Bending Rolls

The "Schatz-Herkules" machines for rolling angles, tees, beams, channels, and flats are being introduced by the Schatz Manufacturing Co., Poughkeepsie, N. Y. These units are available in various sizes for bending angles from smallest sizes up to 8 in. by 8 in. by 1 in. The feature of the machine is the roll adjustment which permits the rolling of different profiles, eliminating the necessity of interchanging the rolls.

The illustration shows sizes BO-8 and BO-9 for rolling angles up to 2 in. by 2 in. by ¼ in. and 2½ in. by 2½ in. by $^5/_{16}$ in., respectively. Horizontal operation permits the handling of the longest bars and largest rings. The guide rolls have both vertical and radial adjustment, which, together with the roll design, can produce rings or arcs absolutely true and round without twisting the material. The machines can be obtained for either unit electric drive or belt drive.



Rolling machine for angles, tees, beams, channels, and flat stock

Among the Clubs and Associations

Toronto Railway Club.—"What Must the Railways Provide?" will be the subject of an address by L. K. Sillcox, first vice-president of the New York Air Brake Company, before the meeting of the Toronto Railway Club to be held on May 17 at Toronto. A musical program will follow the address.

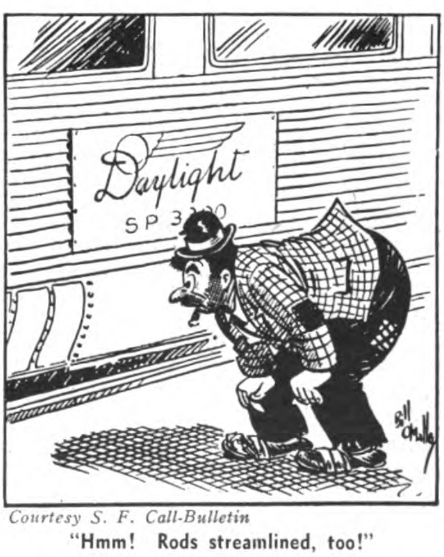
Car Foremen's Association of Chicago.—F. S. Thompson, chief engineer, General American Transportation Corporation, Chicago, is to discuss Tank Cars—Their Design and Services at the meeting of the Car Foremen's Association of Chicago to be held at 8 p.m. daylight saving time on May 10 at the LaSalle Hotel, Chicago.

New York Railroad Club.—The New York Railroad Club at its meeting on Friday evening, May 21, will observe United States Steel Night. C. A. Gill, general manager of the Reading, and president of the club, will make the opening remarks, after which J. R. Mills, manager of sales, Carnegie-Illinois Steel Corporation, will act as master of ceremonies. An address on Research Developments in Steel for Railroad Equipment will be made by A. F. Stuebing, railroad mechanical engineer of the United States Steel Corporation. This will be followed by an address on Rail—Recent Tests and Developments, by F. R. Layng, chief engineer of the Bessemer & Lake Erie. Motion picture films will be shown of the manufacture and treatment of rail and the laying of one mile of experimental welded track on the Bessemer & Lake Erie. The technical program will be followed by several entertainment features.

National Machine Tool Builders' Association.—Important matters of public policy were given unusual prominence at the thirty-fifth spring convention of the National Machine Tool Builders' Association held at the Edgewater Beach hotel, Chicago, May 3-4. In an address showing the vital relation of machine tools to American prosperity, President Clayton R. Burt, President Pratt & Whitney division, Niles-Bement-Pond Company, Hartford, Conn., said that machine tool builders are committed to the principle of "more goods for more people" as a means of creating full employment for all who honestly want to work. He said that machine tool builders have a reputation for fair dealing with employees, with whom they have shared the profits of the industry; that they have co-operated with customers to increase production, thus making possible higher wages and increased distribution of products; that they have never ceased to furnish equipment essential for national defense needs, even though this has meant meeting the higher cost of the Walsh-Healey requirements; that they have contributed heavily to the support of various communities through taxes and service expenditures; and that they have led the procession in establishing sound training courses for young men to supplement school work in well-equipped trade and technical schools and co-operative colleges. ¶Mr. Burt said that machine tool builders are bending their effort to design and supply the master tools which are the foundation for all better living and closed his address with the following comment: "The whole-hearted co-operation of every branch and department of industry to improve quality and lower costs through technical means, in the interest of lower prices and greater employment income, is a project worthy of every encouragement from Washington. It merits freedom from crippling restrictions, fearless reduction of unnecessary government costs and a sincere effort to administer the laws now enacted with fairness to both the management of all business enterprises and to their employees." ¶Following the president's address Tell Berna, general manager of the association, told what the members of the industry are doing and, in the interest of an enlightened public policy, urged the association to continue to place interesting and intimate facts concerning its activities before the public and those in charge of our national affairs. Dr. James S. Thomas, president Clarkson College of Technology, Potsdam, N. Y., addressed the association on "What Machinery Has Done to Mankind" and W. J. Cameron, Ford Motor Company, presented the subject, "Industry and Society." Other subjects of specialized interest were discussed by nationally known speakers.

Air Brake Assn.—The association will hold a meeting at Atlantic City on June 17 and 18, in order to take advantage of the elaborate exhibit which will be held in connection with the meetings of the Mechanical Division and the Purchases and Stores Division of the Association of American Railroads. The headquarters of the Air Brake Association will be at the Haddon Hall Hotel. While the program has not yet been completed, plans are now being made to discuss the new standard "AB" freight car brake; the new H.S.C. passenger brake; the No. 8-ET equipment; inspection and maintenance of brake beam hangers and attachments; F-1 lubricator for steam driven air compressors; and the "AB" empty and load brake equipment.

* * *



Courtesy S. F. Call-Bulletin

"Hmm! Rods streamlined, too!"

American Society of Mechanical Engineers.—Plans for the 1937 semi-annual meeting of the American Society of Mechanical Engineers, to be held at the Hotel Statler, Detroit, Mich., May 17 to 21, inclusive, include a series of six general sessions, mornings and evenings, with plant visits and simultaneous sessions of the various professional divisions on the afternoons of the same days. The general sessions will conclude with a dinner on Thursday evening, May 20, during which honorary membership will be bestowed upon Alex Dow, a past Society president. ¶Among the papers of particular interest to be presented at the spring meeting are:

Tuesday Morning, May 18

Modern Locomotive and Axle Testing Equipment, by T. V. Buckwalter, vice-president; W. C. Sanders, general manager, Railway Division, and O. J. Horger, research engineer, Timken Roller Bearing Co., Canton, Ohio.

Wednesday Morning, May 19

The Aspects of Automotive Engineering Which Have Been Applicable to Railroading, by Edward G. Budd, president, Edward G. Budd Manufacturing Company, Philadelphia, Pa.

The Economics of Power for Light-Weight Trains, by Dr. Rupen Eksergian, Edward G. Budd Manufacturing Company, Philadelphia, Pa.

Wednesday Afternoon, May 19

(Welding Session Co-sponsored by American Welding Society)

Welded Steel in High-Speed Railway Service, by Everett Chapman, president, Lukenweld, Inc., Coatesville, Pa.

Hydromatic Welding of Frames, by C. L. Eksergian, chief engineer, Budd Wheel Co., Philadelphia, Pa.

Thursday Afternoon, May 20

High-Speed Diesel-Engine-Maintenance Practice on the Canadian National Railways, by I. I. Sylvester, special engineer, Canadian National Railways, Montreal.

New Urban Transportation Equipment and New Steam Railroad Equipment, by H. L. Andrews, General Electric Company.

The Grinding of Cemented Carbide Milling Cutters, by Hans Ernst, research engineer, and M. Kronenberg, Cincinnati Milling Machine Co., Cincinnati, Ohio.

Report of Subcommittee on Metal Cutting Data on Reducing Production Costs by More Effective Use of Metal-Cutting Tools, by R. C. Deale.

Friday Morning, May 21

Railroad Streamlining, by A. I. Lipetz, chief consulting engineer, American Locomotive Company, Schenectady, N. Y.

Light-Weight Passenger Train Resistance, by A. I. Lotten, Transportation Engineering Department, General Electric Company.

Western Railway Club.—A meeting devoted to railway purchasing and storekeeping was held by the Western Railway Club in Chicago on April 19. Over 200 members and guests of the club gathered

in the Sherman Hotel to hear an address by G. O. Beale, chief purchases and stores officer of the Chesapeake & Ohio, Pere Marquette and New York, Chicago & St. Louis. Mr. Beale was unavoidably prevented from attending the meeting in person and his paper, "The Modern Purchasing and Stores Department," was presented by R. M. Nelson, purchasing agent, Chesapeake & Ohio. Mr. Nelson paid a tribute to H. C. Pearce, former director of purchases and stores of the Chesapeake & Ohio, for his contributions to advancement of efficient storekeeping and was joined in the tribute by the president of the club, D. C. Curtis, following Mr. Pearce's response. Out of town guests included E. M. Willis, purchasing agent, Northern Pacific; W. R. Culver, general storekeeper, Chesapeake & Ohio; J. T. Kelly, general storekeeper, C. M. St. P. & P., and W. J. Farrell, secretary, purchases and stores division, A. A. R. Other purchasing and stores officers in attendance included E. A. Clifford, general purchasing agent, Chicago & North Western; R. D. Long, purchasing agent, Chicago, Burlington & Quincy; L. L. King, purchasing agent, Illinois Central; L. J. Ahlering, purchasing agent, C. & E. I.; C. H. Kenzel, purchasing agent, E. J. & E.; C. W. Yeaman, purchasing agent, C. & W. I.; and W. S. Morehead, general storekeeper, Ill. Cen.

Freight-Car Maintenance

Car Foremen's Association of Chicago.—At the regular monthly meeting held April 12 at the Hotel LaSalle, Chicago, the principal address was made by K. F. Nystrom, superintendent car department, C. M. St. P. & P., who discussed the subject "Freight Car Maintenance." Mr. Nystrom said, in effect, that the maintenance of freight equipment begins with a comprehensive understanding of car-service requirements and ends at the dismantling plant where the equipment is finally cut up for scrap. He stressed the importance of car design by railway officers experienced in car use, as well as details of technical design and urged that individual car foremen be given an unhampered opportunity to express their opinions, both favorable and otherwise, regarding proposed new features of design. ¶Mr. Nystrom explained how to make the financial analysis necessary in determining whether it is more economical to repair car equipment or purchase new, and gave a general description of Milwaukee practice in making schedule repairs to freight cars on a four-year cycle basis, also in handling annual work at ten system points.

Machine Tools as a National Asset

A.S.M.E., Chicago Section.—At the machine shop practice spring meeting of the Chicago Section, the principal address, "Machine Tools as a National Asset," was made by Raymond S. Perry, vice-president, Ingersoll Milling Machine Company, Rockford, Ill. Mr. Perry presented a general discussion of this subject and, in refuting the argument that machinery is responsible for unemployment and to a certain extent for the present depression, he quoted the National Industrial Conference report as saying that no evidence is available to show that machinery is a real factor in unemployment, either during normal or depression periods. Mr. Perry said that his company looks on machinery as an investment of money to make money and that only a very small percentage of machine-tool purchasers have any well-defined method of determining the real value of machinery or deciding when it is economical to retire and replace existing equipment. ¶In this connection, the fact was developed that 60 per cent of the machine-tool buyers who have a definite plan of replacing machine tools purchase new equipment when the estimated direct labor savings in a specific period of time will equal the investment cost. In the case of some automobile manufacturers this period is as short as 144 days. With other manufacturers it is 6 months and with still others, including the railroads, possibly 3 to 5 years.

Mr. Perry emphasized the necessity of looking at machinery, not from the standpoint of age alone but serviceability as well, since it is by no means impossible to find a 30-year-old machine which, for a certain operation under special conditions, is doing very good work and cannot be economically replaced. Mr. Perry said he does not believe that any hard and fast formula can be developed for the purchase of machinery which will be generally applicable in all circumstances, but that all of the numerous factors must be studied individually in the light of special conditions under which each tool will be used.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

Air-Brake Association.—T. L. Burton, care of Westinghouse Air Brake Company, 3400 Empire State Building, New York.

Allied Railway Supply Association.—F. W. Venton, Crane Company, Chicago.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet avenue, Chicago.

American Society of Mechanical Engineers.—C. E. Davies, 29 West Thirty-ninth street, New York. Semi-annual meeting, May 17-21.

Railroad Division.—Marion B. Richardson, 21 Hazel avenue, Livingston, N. J.

Machine Shop Practice Division.—J. R. Weaver, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Materials Handling Division. — F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

Oil and Gas Power Division. — M. J. Reed, 2 West Forty-fifth street, New York.

Fuels Division.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

Association of American Railroads. — J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

Division I. — Operating. — Safety Section.—J. C. Caviston, 30 Vesey street, New York.

Division V.—Mechanical.—V. R. Hawthorne, 59 East Van Buren street, Chicago. 1937 convention, June 16-23, Atlantic City, N. J.

Committee on Research. — E. B. Hall, chairman, care of Chicago & North Western, Chicago.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey street, New York. Annual meeting, June 21, 22 and 23, Atlantic City, N. J.

Division VIII.—Motor Transport.—Car Service Division. — George M. Campbell, Transportation Building, Washington, D. C.

Association of Railway Electrical Engineers.—Jos. A. Andreucetti, C. & N. W., 1519 Daily News Building, 400 West Madison street, Chicago, Ill.

Canadian Railway Club.—C. R. Crook, 2271 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month, except in June, July and August at Windsor Hotel, Montreal, Que.

Car Department Officers' Association.—A. S. Sternberg, master car builder, Belt Railway of Chicago, 7926 South Morgan street, Chicago.

Car Foremen's Association of Chicago.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

Car Foremen's Association of Omaha, Council Bluffs and South Omaha Interchange.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p. m.

Central Railway Club of Buffalo.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

Eastern Car Foremen's Association. — E. L. Brown, care of the Baltimore & Ohio, St. George, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

Indianapolis Car Inspection Association.—R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

International Railway Fuel Association.—See Railway Fuel and Traveling Engineers' Association.

International Railway General Foremen's Association.—William Hall, 1061 West Wabasha street, Winona, Minn. Next meeting, September 28 and 29, Hotel Sherman, Chicago, Ill.

International Railway Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

Master Boiler Makers' Association. — A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y. Annual meeting, September 29 and 30, Hotel Sherman, Chicago.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September, at Hotel Touraine, Boston.

New York Railroad Club.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July, August and September, at 29 West Thirty-ninth street, New York.

Northwest Car Men's Association. — E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, University and Prior avenue, St. Paul.

Pacific Railway Club.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Calif., alternately—June in Los Angeles and October in Sacramento.

Railway Club of Greenville. — J. Howard Waite, 43 Chambers avenue, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

Railway Fire Protection Association.—P. A. Bissell, 40 Broad street, Boston, Mass. Annual meeting, October 19-20, 1937.

Railway Fuel and Traveling Engineers' Association.—T. Duff Smith, 1255 Old Colony building, Chicago. Annual meeting, with exhibits, Hotel Sherman, Chicago, September 28, 29, 30.

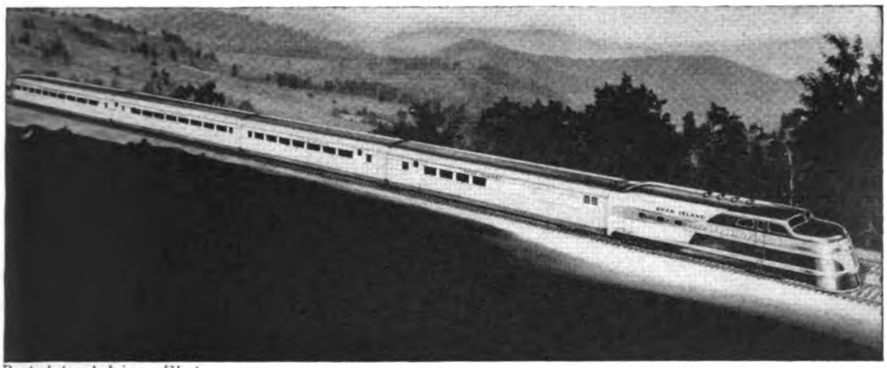
Railway Supply Manufacturers' Association.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, Association of American Railroads. Exhibit June 16 to 23, inclusive, Atlantic City, N. J.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

Toronto Railway Club.—R. H. Burgess, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

Traveling Engineers' Association.—See Railway Fuel and Traveling Engineers' Association.

Western Railway Club.—C. L. Emerson, executive secretary, 822 Straus Building, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.



Rock Island Lines Photo

An artist's sketch of one of the "Rockets" being constructed by the Edward G. Budd Manufacturing Company for the Chicago, Rock Island & Pacific

NEWS

Swedish Turbine Locomotive—A Correction

THE tonnage hauled by the turbine locomotives on the Grangesberg-Oxelosund Railways in Sweden is 1,750 tons on 1 per cent ruling grades and not 750 tons as given in the item on page 46 of the January issue.

Conventional Steel Coaches Rebuilt for New Royal Blue

THE Baltimore & Ohio placed in service on April 25 an eight-car streamline train which has taken the name of the Royal Blue and operates on the same schedule as the original train of that name, leaving New York in the morning for early afternoon arrival in Washington and starting the return run from Washington at 3:45 p.m. The train, which consists of a combination smoker-baggage, four coaches, a diner and a chair car and observation car, was designed and the cars rebuilt at the Mt. Clare shops of the B. & O., Baltimore.

A feature of three of the four coaches in the train is the unusually large lounge and smoking rooms for women, which are adjacent to the lavatory. One coach has a lunch counter. The dining car is divided into two compartments, one serving as a regular diner and the other, which seats 10 people, furnishing counter service. Furnishings are bright in color.

The standard-weight steel coaches which comprise the new train have been fitted with roofs of oval section, eliminating the clerestory, and, except for the rear end of the last car in the train, without hoods. The space between the ends of adjoining cars is closed by diaphragms which conform to the roof and side contour so that the train presents unbroken roof and side surfaces from end to end. The sides have been extended downward in an inwardly curving skirting which partially conceals the equipment mounted underneath the car, and the step wells are so enclosed that the surfaces of the sides of the car are unbroken when the vestibule trap doors are closed. The cars are carried on six-wheel rubber-insulated trucks, such as have been in service on the road for several years. The equipment includes O-B tight-lock couplers similar to those on the original light-weight Royal Blue cars.

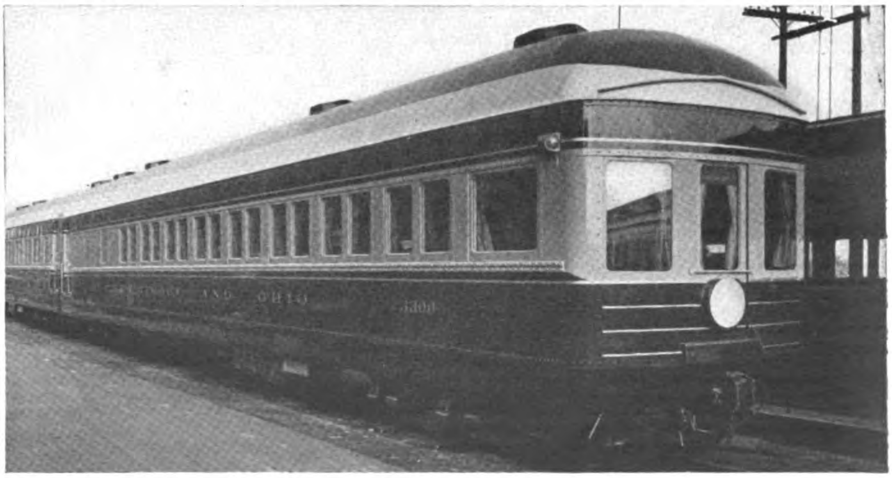
Labor Act Upheld

THE Supreme Court, in a unanimous opinion read by Justice Stone, on March 29, upheld the constitutionality of the Railway Labor Act as amended in 1934 and declared that the act applied to back-shop mechanical workers of a railroad. The case was brought by the Virginian against the System Federation No. 40. The railroad had contended that the back-shop mechanical men who were engaged in building and repairing cars and locomotives were not engaged in interstate commerce. The court held that since the men were working on equipment which was to be used to haul interstate traffic, they were definitely engaged in interstate commerce. The decision also upholds the validity of the National Mediation Board certificate designating System Federation 40 as the duly accredited representative of the back-shop employees.

The court found "no answer" in the railroad's contention that it could close its shops and turn over the repair work to contractors. This, it is conceded, "is a question of railroad management," but it is nevertheless held that the road's determination to do its own repairs has brought its relations with shop employees within the purview of the Railway Labor Act.

On the question of the validity of the National Mediation Board certificate the court discussed the railroad's contention that a majority of those eligible to vote must favor a union before the latter may be accredited. System Federation 40 received the certificate after it was favored by a majority of those voting. The court in this connection notes that the law confers the right of determination on a ma-

Rear end of the new Royal Blue of the Baltimore & Ohio



jority of those eligible to vote "but is silent as to the manner in which that right shall be exercised." It proceeds to cite cases wherein election laws have been generally construed as requiring only the consent "of the specified majority of those participating in the election," quoting one of the cited authority to the effect that those who do not participate "are presumed to assent to the expressed will of the majority of those voting." The court also notes that "the absence of eligible voters may be due less to their indifference than to coercion by the employer."

"Forty-Niner" to Augment "City of San Francisco"

A NEW steam train, which will be known as the "Forty-Niner" and the schedule of which will be staggered with that of the Streamliner City of San Francisco, will be placed in service between Chicago and San Francisco by the Chicago & North Western, the Union Pacific and the Southern Pacific about June 15. The train will be operated on a schedule of 50 hr. 42 min. westbound, and 49 hr. eastbound, for the 2,260 miles, the latter time being the basis for the train's name. It will leave Chicago at 10:10 a.m. on the 2, 8, 14, 20 and 26th days of each month, and will arrive in San Francisco at 10:52 a.m. the third morning. Returning it will leave San Francisco shortly before noon on the 5, 11, 17, 23 and 29th days of each month.

The Forty-Niner, drawn by a steam locomotive, will be an eight-car train, air-conditioned throughout, with sections, drawing rooms, compartments and single and double bedrooms, lounge accommodations and barber shop, the capacity of all accommodations being adequate for 115 persons. An extra fare of $10 will be charged. The standard Pullman cars in the train will have rounded roofs, so that, in combination with the two-car, light-weight, articulated units Advanced and Progress, which the Pullman Company introduced last September, the train will be of streamliner design. In this two-car unit, which will be located at the rear of the train, the head car, of duplex style, consists of 16 single bedrooms, 7 of which are upstairs, and the remainder on the regular level, or downstairs. The rear car contains rooms, buffet and lounge, the forward half being given over to three double bedrooms and one compartment. A buffet will serve light refreshments, and the lounge, taking up one half of the car, will seat 26 persons.

Railway Strike Threat Ended in Canada

DURING the week ended April 3 organized Canadian railwaymen, 117,000 strong, and managements of the two Canadian railways in Montreal reached an agreement on a plan for restoration of wage cuts which removed the threat of a tie-up in the Dominion's transportation.

Members of the 18 standard unions will have the entire deduction returned to them in ten progressive steps within the next year.

The pact terminated a controversy which began in March, 1935, when union officers applied for a board of conciliation to weigh their request for return of a 10 per cent cut in wages voluntarily accepted by employees early in 1932. It also dispelled a threat of a paralyzing strike which loomed since early in February when union leaders flatly rejected the majority report of the conciliation board, which ended several months of deliberations by recommending that railways give their employees three per cent of the ten per cent deduction in serrated steps before the year's end.

(*Continued on next left-hand page*)

New Equipment Orders and Inquiries Announced Since the Closing of the April Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Aliquippa & Southern	2	0-8-0	American Locomotive Co.
A. C. L.	12	4-8-4	Baldwin Locomotive Works
Bangor & Aroostook	5	2-8-0	American Locomotive Co.
C. R. I. & P.	10 [1]	600-hp. Diesel-elec. switch.	Electro-Motive Corp.
Grt. Western	1	2-8-0	American Locomotive Co.
Mo. Pac.	4 [2]	600-hp. Diesel-elec. switch.	Electro-Motive Corp.
	2 [2]	900-hp. Diesel-elec.	Electro-Motive Corp.
M. St. P. & S. Ste. M.	4	4-8-4	Lima Locomotive Works
Nat'l Rys. of Mexico	8 [3]	2-6-6-2	American Locomotive Co.
	10 [3]	4-6-4	American Locomotive Co.
Pennsylvania	11 [4]	Elec.-loco. chasses	Company shops
R. F. & P.	6	4-8-4	Baldwin Locomotive Works
St. L.-S. F.	16	....	Company shops
Youngstown & Northern	1	0-6-0	Lima Locomotive Works

LOCOMOTIVE INQUIRIES

Road	No. of locos.	Type of loco.	Builder
Alton & Southern	1 or 2	2-8-2	....
Chinese Ministry of Rys.	40-65	2-8-2	....
	10	2-8-4	....

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
A. C. L.	100	Phosphate	Bethlehem Steel Co.
	400	Box	Mt. Vernon Car Mfg. Co.
	200	Automobile	Mt. Vernon Car Mfg. Co.
Birmingham-Southern	25	70-ton gondola	Pullman-Standard Car Mfg. Co.
C. B. & Q.	25	70-ton gondola	Pullman-Standard Car Mfg. Co.
C. M. St. P. & P.	500	50-ton steel hopper	Company shops
	500	50-ton automobile	Company shops
	1,000	Gondola	Company shops
	22	Air dump	Company shops
C. N. O. & T. P.	1,250 [5]	50-ton H. S. gondola	American Car & Foundry Co.
	2,059 [5]	40-ton box	Pullman-Standard Car Mfg. Co.
	250 [5]	50-ton L. S. gondola	Pullman-Standard Car Mfg. Co.
	500 [5]	40-ton box	Mt. Vernon Car Mfg. Co.
	500 [5]	40-ton automobile	Mt. Vernon Car Mfg. Co.
	1,100 [5]	50-ton hopper	Pressed Steel Car Co.
Lake Superior & Ishpeming	300	Ore	Bethlehem Steel Co.
L. & N. E.	75	70-ton covered hopper	American Car & Foundry Co.
Louisiana & Arkansas	50 [6]	Box	Pullman-Standard Car Mfg. Co.
	50	70-ton steel hopper	General American Trans. Corp.
M. St. P. & S. Ste. M.	250 [7]	Automobile	Pullman-Standard Car Mfg. Co.
	100 [7]	General service	Pullman-Standard Car Mfg. Co.
	100 [7]	Hopper	Pullman-Standard Car Mfg. Co.
	100 [7]	50-ton Rodger ballast	American Car & Foundry Co.
Nat'l Rys. of Mexico	250	30-ton narrow-gage box	Pullman-Standard Car Mfg. Co.
	150	50-ton std.-gage box	Pullman-Standard Car Mfg. Co.
	250 sets	of 40-ton std.-gage trucks	Pullman-Standard Car Mfg. Co.
	175	Std.-gage box	American Car & Foundry Co.
	175	Std.-gage box	General American Trans. Corp.
Pennsylvania	1,500 [4]	Box	Company shops
	1,000 [4]	Gondolas	Company shops
	300 [4]	Covered hopper	Company shops
Tenn. Coal, Iron & R. R. Co.	19	70-ton ore	Pullman-Standard Car Mfg. Co.
	21	70-ton gondola	Pullman-Standard Car Mfg. Co.

FREIGHT-CAR INQUIRIES

Road	No. of cars	Type of car	Builder
Union Pacific	750-3,000 [8]	....	....
	1,000	50-ton gondolas	....

PASSENGER-CAR ORDERS

Road	No. of locos.	Type of loco.	Builder
A. C. L.	20	Coaches	Bethlehem Steel Co.
	15	Express	Bethlehem Steel Co.
Can. Nat'l	50 [9]	Coaches	Canadian Car & Foundry Co.
C. M. St. P. & P.[10]	7	Diners	Company shops
	1	Mail-express	Company shops
	5	Coach-baggage	Company shops
N. & W.	9	Postal	Bethlehem Steel Co.

PASSENGER-CAR INQUIRIES

Road	No.	Type	Builder
G. T. W.	3	Baggage	....

[1] The Rock Island has been authorized by the Federal District Court at Chicago to lease for 7 years, with the right to purchase, ten 100-ton 600-hp. Diesel-electric switching locomotives from the Electro-Motive Corporation. These locomotives, having a value of $700,000, will probably be used at Des Moines, Iowa; Kansas City, Mo.; Peoria, Rock Island, Joliet and Chicago, Ill.

[2] The 600-hp. locomotives are for use at various points, and the two 900-hp. for use between St. Louis, Mo., and Kansas City.

[3] The eight articulated locomotives of the 2-6-6-2 type to have 18-in. by 30-in. cylinders and weigh 410,000 lb. in working order and the 10 locomotives of the 4-6-4 type, to have 22½-in. by 28-in. cylinders and weigh 300,000 lb. in working order.

[4] The cars include 1,000 double-door box, 50 ft. long, adapted to the transportation of general freight including automobiles; 1,500 mill-type gondola cars, 52 ft. long and of 70 tons' capacity, and 300 covered hopper cars for carrying, in bulk, cement and other commodities requiring protection from the weather. The 11 new electric passenger locomotives are to be of the G. G. 1 type. These locomotives will be assembled at Altoona, with electrical parts supplied by the electrical manufacturing companies. The total cost of this equipment is estimated at $10,750,000.

[5] Of these, 1,000 box, 250 low-side gondola, 250 high-side gondola and 600 hopper, a total of 2,100 cars, are for service on the Alabama Great Southern, and the other 3,500 cars are for service on the Cincinnati, New Orleans & Texas Pacific.

[6] In addition to 100 reported ordered from Pullman-Standard in March issue.

[7] For the Wisconsin Central.

[8] For use in preparing appropriations.

[9] These coaches will be air-conditioned and will have a seating capacity of 64, reclining seats, high tensile steel bodies, turtle back roof, and six wheel trucks.

[10] An order has also been placed with company shops for the modernization and air conditioning of 30 coaches.

The Labor Department in Ottawa has more recently announced that a board of conciliation had recommended restoration by next April 1 of 10 per cent wage deductions to about 10,000 Canadian National employees, members of the Canadian Brotherhood of Railway Employees.

The board, in a unanimous finding, recommended, in effect, the same treatment of these employees in the matter of pay restoration as the railways will accord members of the standard labor organizations.

Burlington Streamline Steam Locomotive Completed

THE first of two streamline steam locomotives, in which reciprocating parts are designed to meet the demands of high-speed operation, has been completed in the West Burlington, Iowa, shops of the Chicago, Burlington & Quincy, and, after a series of road tests, will be placed in regular service as a relief locomotive on the Zephyr runs between Chicago and Denver, Colo., between Chicago and the Twin Cities, and in other high speed passenger service. At ceremonies held at the shops on April 11 and attended by 5,000 people, the first locomotive was christened "Aeolus." The name, taken from Greek Mythology, means "keeper of the winds." The stainless-steel sheets which encase the locomotive and tender give the locomotive an appearance similar to that of the Zephyrs. The Aeolus, a 4-6-4 type locomotive, burns coal and is capable of speeds of more than 100 miles an hour. Because of the design of reciprocating parts, the destructive effect on the track will be less than that of conventional locomotives operating at high speeds.

I. C. C. Authorizes Construction of Fusion-Welded Tank Cars

THE Interstate Commerce Commission, Division 3, has authorized the construction for experimental service of 55 tank cars, to be fabricated by the fusion-welding process, in addition to those authorized last year as referred to in an item on page 273 of the June, 1936, issue of the *Railway Mechanical Engineer*. The decision grants the application of the General American Transportation Corporation for permission to build 50 such cars for the transportation of petroleum products; that of the E. I. duPont de Nemours & Company for authority to build one for the transportation of nitric acid; and that of the Texas Chemical Company for permission to construct four for the transportation of muriatic acid. Also service restrictions applied to a car previously constructed by the duPont company are removed and no such limitations as to operation between specific points and over specified routes are to be applied to that company's new car.

The 50 General American cars will conform with I.C.C. specification 105-A-300, except that the tanks will be fusion welded instead of forge welded, in compliance with proposed revised I.C.C. specification 105-A-300-W. The duPont car will conform with I.C.C. specification 103-C, except that the tank will be constructed by fusion welding instead of riveting and caulking, and will be marked in compliance with proposed revised specification 103-C-W. The four Texas Company cars will conform with I.C.C. specification 103-B, except that fusion welding will be employed instead of riveting and caulking, in compliance with proposed revised I.C.C. specification 103-B-W.

Reading To Purchase Train

THE Reading has authorized the purchase of a train of standard lightweight equipment to be built by the Edward G. Budd Manufacturing Company of stainless steel. The train will be operated between Philadelphia and New York by a streamline Pacific type steam locomotive.

Supply Trade Notes

L. A. BEDARD has been appointed manager of sales of the Mt. Vernon Car Manufacturing Company, Mt. Vernon, Ill.

THE DEVILBISS COMPANY, Toledo, Ohio, will erect a new plant, 120 ft. by 440 ft., on Lagrange street near the Ottawa river, Toledo, to expand its rubber products division.

THE LINDE AIR PRODUCTS COMPANY, unit of Union Carbide and Carbon Corporation, has opened an oxygen plant on Powhattan avenue, Essington, Pa. A Prest-O-Lite acetylene plant has been opened at 2330 Armistead Bridge Rd., Norfolk, Va.

LEO F. DUFFY, formerly of the western railroad sales department of the Chicago Pneumatic Tool Company, has joined the sales organization of the Youngstown Steel Door Company and the Camel Sales Company, at Chicago.

THE CARBOLOY COMPANY, INC., Detroit, Mich., has added P. H. Holton to the sales engineering personnel of the Philadelphia territory. Mr. Schonberger, formerly of the Philadelphia territory, has been transferred to Newark, N. J.

FRANK L. JOHNSON has been appointed vice-president in charge of sales and operations of the western district of the Pressed Steel Car Company, Inc., with headquarters at Chicago. Mr. Johnson was born in Chicago, where he attended elementary schools and college. He entered the employ of the Pressed Steel Car Company, in the engineering department, at Chicago, in 1906 and on January 1, 1913, was transferred to the western district sales department as sales agent. In January, 1928, he was promoted to the position of assistant general sales manager, western district, and in July, 1933, to general sales manager, western district. Since February, 1934, Mr. Johnson has served as vice-president of the Pressed Steel Car Company of Illinois.

ROLAND W. BURT has been appointed eastern manager of railroad sales for Joseph T. Ryerson & Son, Inc., with headquarters at the Jersey City, N. J., office of the company. Mr. Burt has been with the Ryerson company for 14 years, advancing through its various sales divisions to the position of sales representative in the state of Indiana. Later Mr. Burt took charge of railroad sales at St. Louis, Mo.

(c) *Koehne*

Roland W. Burt

THOMAS W. DELANTY, manager of eastern railroad sales for Joseph T. Ryerson & Son, Inc., who has been representing that company in a sales capacity both in this country and in the Far East since 1918, has resigned to become associated vice-president of the Ajax Hand Brake Company, with headquarters at Chicago.

L. J. REAY has been appointed president of the Mahr Manufacturing Company, manufacturing division of the Diamond Iron Works, Inc., Minneapolis, Minn. G. A. Bingenheimer, formerly president, has become chairman of the board. Other members of the Executive council include W. G. Barstow, vice-president in charge of general business promotion, and his assistant, O. E. Ertl; W. H. Ridell, secretary and treasurer, and C. F. Olmstead, Chief engineer.

CRAIG W. MARSHALL has been appointed district manager, eastern territory, railroad division of The Dayton Rubber Manufacturing Company, with headquarters at 11 Park Place, New York City. He succeeds E. J. Schmidt, who has been transferred to the home office division, where he will act in an executive sales engineering capacity. Mr. Marshall has been associated for the past 11 years with the Sunbeam Electric Manufacturing Company, as eastern sales manager of railroad equipment.

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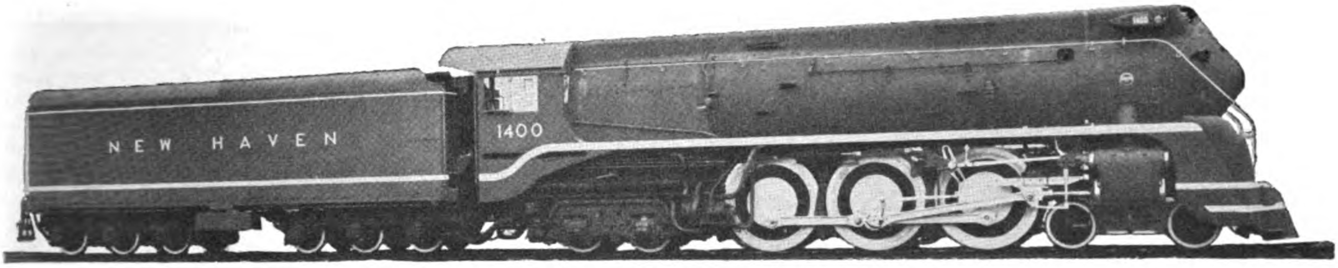

POWER

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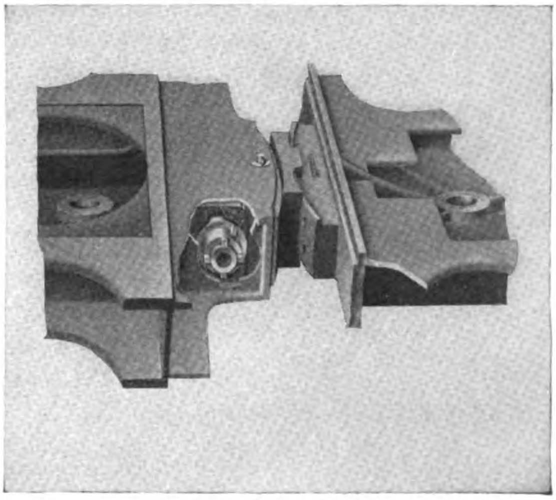
HIGH SPEED DE LUXE SERVICE

On these ten 4-6-4 Type Streamlined Passenger locomotives built by Baldwin for The New York, New Haven and Hartford Railroad Company, the Type E-2 Radial Buffer between engine and tender will aid in smooth operation and improve the riding of the locomotive.

The Franklin Type E-2 Radial Buffer maintains a pre-determined spring-held, frictional resistance between engine and tender that avoids all slack, yet permits free movement in any direction between engine and tender units.

This controlled frictional resistance dampens all oscillation and cushions and absorbs the shocks.

By avoiding slack and jar it protects against excessive stress on drawbar and pins, increases safety of operation and adds to passenger comfort by improving the smoothness of the entire train movement.



Franklin Type E-2 Radial Buffer

REG. U.S. PAT. OFF.

Because material and tolerances are just right for the job, genuine Franklin repair parts give maximum service life.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

W. J. MONTGOMERY of the Sherwin-Williams Company, Cleveland, Ohio, has been appointed general manager of transportation sales. Mr. Montgomery, who succeeded K. H. Wood, now vice-president and general sales manager for the company, has for some years served as assistant manager of transportation sales.

J. E. PETERSON has been elected vice-president and assistant to the president of the General Machinery Corporation. Mr. Peterson has his headquarters at Hamilton, Ohio. He has been with the company 22 years, having joined the Hooven, Owens, Rentschler Company, a division of the General Machinery Corporation, in 1914.

THE TIMKEN ROLLER BEARING COMPANY, Canton, Ohio, has appointed district managers in charge of steel sales for its Steel and Tube Division as follows; W. F. Anderson, St. Louis, Mo.; M. C. Bellamy, Seattle, Wash.; G. W. Curtis, Milwaukee, Wis.; H. V. Fleming, Birmingham, Ala.; B. E. Keifer, Cincinnati, Ohio; H. D. Robb, Pittsburgh, Pa., and B. M. Tinlin, Huntington, W. Va.

THE HOMESTEAD VALVE MANUFACTURING CO., INC., Hypressure Jenney Division, Corapolis, Pa., has appointed the following distributors for handling exclusively its line of chemical vapor-spray-cleaning machines: Toledo Equipment & Supply Co., 1007 Jefferson avenue, Toledo, Ohio; Oil Burner Equipment Co., 502 Lafayette street, Tampa, Fla.; Merkel & Roberts, 478 E. Erie street, Painesville, Ohio, and Gleasner Corporation, 217 Leroy avenue, Buffalo, N. Y.

WALTER J. TAFT, who has been a member of the editorial staff of Railway Age in New York for the past nine years, took charge of the Washington editorial office of the Simmons-Boardman publications on April 17. Mr. Taft's experience with the Simmons-Boardman Publishing Corporation has been primarily in the handling of general news assignments for the Railway Age—both from an editorial and reportorial standpoint. He is thoroughly familiar with the literature on all aspects of railroads—rate questions, regulation and labor matters in particular. He came to the Simmons-Boardman Publishing Corporation in April, 1928, having already had both railroad and newspaper experience. Born on July 29, 1902 at Glendale, R. I., he attended public school at Pascoag, R. I., and the LaSalle Academy at Providence. He received his A.B degree from Providence College in 1924. In 1924-25 he was a reporter for the Providence Evening Tribune. In 1925-27 he attended the Harvard Business School (taking Professor Cunningham's courses in railroad transportation), from which institution he was graduated in the latter year with the degree of Master of Business Administration. In the summer of 1926, Mr. Taft worked in the accounting office of the New Haven at Harlem river, New York. From July to December, 1927, he was a clerk in the engineering department of the Bangor & Aroostock at Houlton, Me. From January to April, 1928, he was a statistician in the service of the Boston & Maine at Boston, which position he left to join the staff of Railway Age.

W. J. Taft

THE ELLCON COMPANY, New York, and the Wellman Bronze & Aluminum Company, Cleveland, Ohio, have combined their sales and manufacturing activities. The Wellman Bronze & Aluminum Company will, in addition to its products, manufacture those heretofore produced by The Ellcon Company, and direct the sale of these products from Cleveland west. The Ellcon Company will handle the sales of both companies, maintaining its present sales office at 50 Church street, New York, covering the district east of Buffalo, N. Y., and Pittsburgh, Pa., south.

THE AMERICAN BRAKE SHOE & FOUNDRY COMPANY, New York, has consolidated the American Forge Company and the Southern Wheel Company with the parent company. These are now known as the American Forge and Southern Wheel Divisions, respectively, of The American Brake Shoe & Foundry Company. Consolidation of certain other subsidiary companies, and their organizations as divisions of The American Brake Shoe & Foundry Company, will take place as fast as is practicable. In line with this program of creating a division which is devoted to the production and sale of a particular line of products, the Brake Shoe Division has recently been created. This division produces, in addition to brake shoes, certain miscellaneous iron castings. Maurice N. Trainer, vice-president, has been placed in charge of the Brake Shoe Division and all departments of this division now report to him. The American Brake Shoe & Foundry Company and its Southern Wheel Division has moved the St. Louis sales office to the Railway Exchange building, St. Louis, Mo. O. W. Spencer will represent both companies at St. Louis.

O. J. PARKS has been appointed general superintendent of the tank-car-repair department of the General American Transportation Corporation, with headquarters in Chicago, to succeed I. A. Eakins, who has retired after many years' service with the General American Company. Mr. Parks was employed by the Pennsylvania railroad in its car department prior to coming to the General American Transportation Corporation 22 years ago, since which time he has served as general superintendent and manager of sales in the freight car department. He is now taking over the supervision of maintenance of all tank cars of the company. Richard M. Lamport has been appointed sales representative, with headquarters in Chicago, to assist in the sales of freight cars and special car equipment. Mr. Lamport came to the company five years ago, after his graduation from Boudoin college.

Obituary

FRANK F. KISTER, chairman of the board of directors of the Q & C Company, New York, died on April 5, at his home in Brooklyn, N. Y., at the age of 64 years. Mr. Kister had served for 45 years with this company, and for more than 20 years was its president and treasurer.

PAUL W. DIETER, inventor and president of the Dieter Bearings Corporation and the Standard Safety Nut Corporation, died on April 5, at the Fifth Avenue Hotel, New York. Mr. Dieter was born at Springfield, Ohio, 53 years ago, and had been in the railroad supply business for about 30 years. Five years ago he patented the Dieter bearing, a journal bearing for locomotives and cars. He also devised various forms of lock nuts, a floating bearing for locomotives, hose fixtures and other items.

EDWARD M. SAWYER, formerly a railroad man, and for many years general manager of the railroad department of the International Correspondence Schools, Scranton, Pa., died in that city on April 20, at the age of 74 years. He was a native of Canada and began his railroad career in 1887 as a fireman on the Canadian Pacific; since 1899 he had been associated with the International Correspondence Schools. He was a member of the Air-Brake Association, International Railway Fuel Association, and a number of railroad clubs.

WILLIAM C. HEDGCOCK, chief mechanical engineer of the American Steel Foundries, died on April 18 at Evanston, Ill., of leucocythemia. He was born in 1889 at Jeffersonville, Ind., and entered the employ of the Louisville & Nashville as a blueprint boy, from which position he progressed to assistant mechanical engineer. Later he became mechanical engineer of the Chicago, Indianapolis & Louisville at Lafayette, Ind. In 1913 he entered the engineering department of the American Steel Foundries. Immediately upon the declaration of war, he enlisted in the Ordnance department and was assigned to staff duty in Washington, achieving the rank of major in the Ordnance design division. After the war he returned to the employ of the American Steel Foundries and in 1929 was appointed chief mechanical engineer, which position he held until his death.

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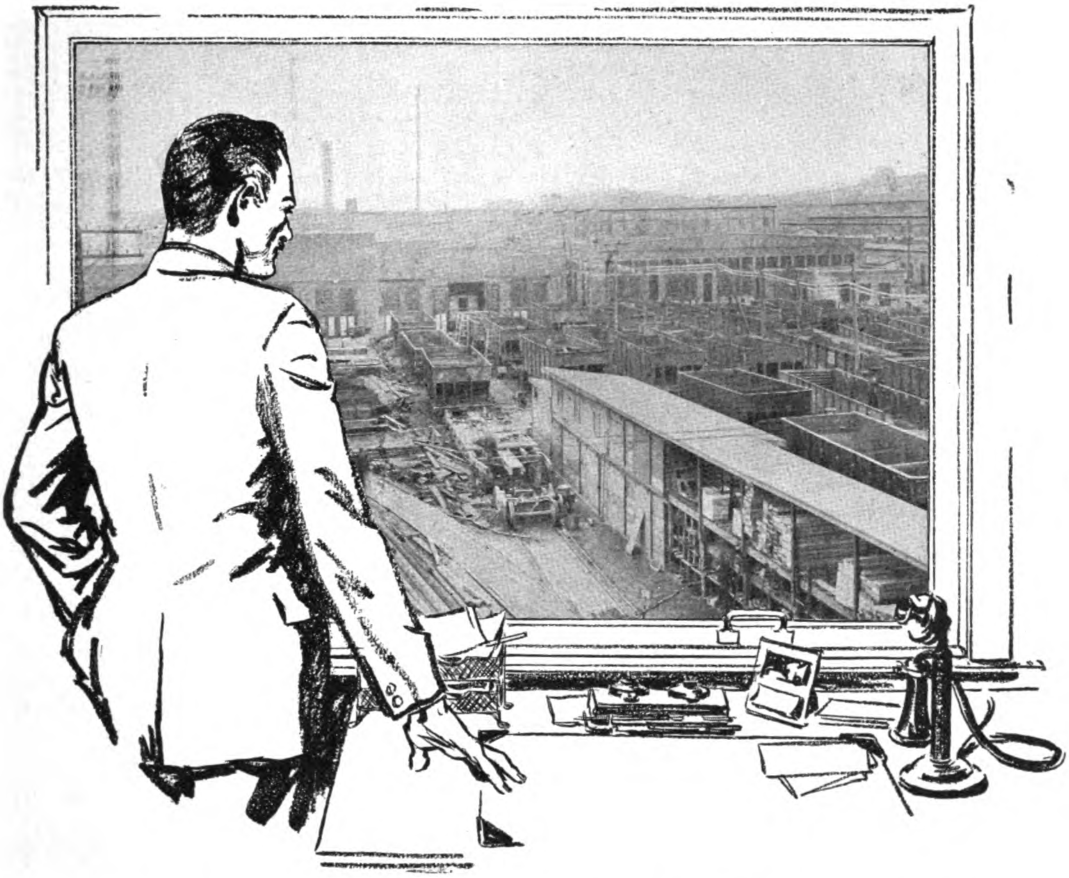


Personal Mention

General

L. B. Jones, master mechanic of the Columbus, Cincinnati and Toledo divisions of the Pennsylvania, has been appointed engineer of tests at Altoona, succeeding F. M. Waring.

C. K. Steins, master mechanic of the Maryland and Baltimore divisions of the Pennsylvania at Wilmington, Del., has been appointed assistant chief of motive power (locomotives), with headquarters at Philadelphia, Pa.

C. T. Hunt, acting assistant master mechanic of the Pennsylvania at Wilmington, Del., has been appointed assistant engineer motive power, office of superintendent of motive power, Southern division.

A. O. Geertz, assistant master mechanic of the Pennsylvania at Altoona, Pa., has been appointed assistant engineer motive power, office of superintendent of motive power, Western Pennsylvania division.

F. M. Waring, engineer of tests of the Pennsylvania at the Altoona, Pa., Works, has been appointed resident inspector, test department, with headquarters at Philadelphia, succeeding W. R. Garden, retired.

R. G. McAndrew, mechanical engineer of the New York, Ontario & Western, has been appointed superintendent of motive power, with headquarters as before at Middletown, N. Y., succeeding B. P. Flory,

R. G. McAndrew

who has retired. Mr. McAndrew was born on February 25, 1895, at St. Thomas, Ont. He was graduated from the University of Michigan (B.S.M.E.) and entered railroad service in 1916 as special apprentice with the Michigan Central. From 1919 to 1923 Mr. McAndrew served as an enginehouse foreman of the Michigan Central and from 1923 to 1928 was drafting, testing and enginehouse foreman of the Denver & Rio Grande Western. He was appointed mechanical engineer of the New York, Ontario & Western in 1929.

L. W. Downey, who has been connected with the Electro-Motive Corporation, La Grange, Ill., has been appointed to the newly-created position of supervisor of automotive equipment of the Chicago, Rock Island & Pacific, with headquarters at Chicago. Mr. Downey will have direct jurisdiction over the maintenance of Diesel and other automotive equipment.

Burton P. Flory, superintendent of motive power of the New York, Ontario & Western, with headquarters at Middletown, N. Y., has retired. Mr. Flory was

B. P. Flory

born on November 9, 1873, at Susquehanna, Pa., and was graduated from Cornell University in 1895, with a degree in mechanical engineering. He entered railroad service in September, 1899, with the Lehigh Valley and served as inspector and mechanical engineer until 1904, when he became mechanical engineer of the Central of New Jersey. He served in the latter capacity until January 1, 1909, when he was appointed superintendent of motive power of the New York, Ontario & Western at Middletown. Mr. Flory is a past president of the New York Railroad Club and a member of the American Society of Mechanical Engineers and the American Society for Testing Materials.

Master Mechanics and Road Foremen

C. A. Wilson, master mechanic of the Atlantic division of the Pennsylvania, has been appointed master mechanic of the Williamsport division.

H. T. Cover, master mechanic of the Eastern division of the Pennsylvania, has been appointed master mechanic of the Maryland and Baltimore divisions.

J. L. Marks, enginehouse foreman of the Pennsylvania, has been appointed assistant master mechanic of the Middle division.

R. J. Conrad, enginehouse foreman of the Pennsylvania, has been appointed assistant master mechanic of the Philadelphia division.

A. W. Byron, master mechanic of the Williamsport division of the Pennsylvania, has been appointed master mechanic of the Philadelphia Terminal division.

C. A. Shull, master mechanic of the Philadelphia Terminal division of the Pennsylvania, has been appointed master mechanic of the Western Pennsylvania division.

J. W. Leonard, assistant master mechanic of the Pennsylvania at Harrisburg, Pa., has been appointed master mechanic of the Atlantic division and of the Pennsylvania-Reading Seashore Lines.

J. N. Fox, general foreman at Markham yard of the Illinois Central at Chicago, has been appointed master mechanic, with headquarters at Jackson, Tenn., succeeding L. A. Kuhns, deceased.

K. L. Roberts, assistant road foreman of engines of the Panhandle division of the Pennsylvania, has been appointed assistant road foreman of engines, Pittsburgh division.

W. Howard Jackson, shop inspector of the Norfolk & Western at Bluefield, W. Va., has been promoted to the position of assistant road foreman of engines of the Pocahontas division, succeeding H. C. Wyatt.

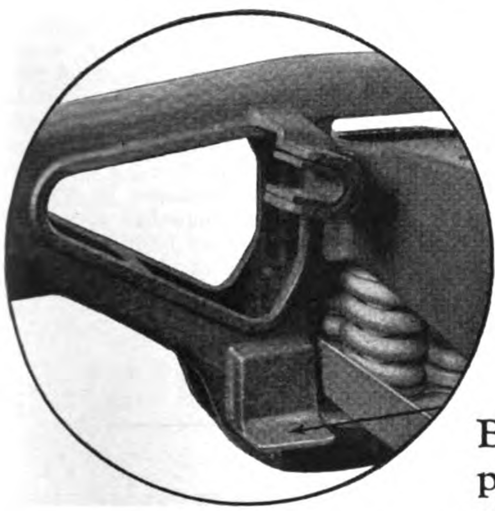
James W. McKinnon, who has been appointed division master mechanic of the Canadian Pacific, with headquarters at Edmonton, Alta., as noted in the March issue of the *Railway Mechanical Engineer,*

J. W. McKinnon

was born on August 29, 1891, at Kenora, Ont., and was educated at St. Mary's school Winnipeg, Man. He entered the service of the Canadian Pacific on July 15, 1908, as a machinist apprentice at the Weston shops, Winnipeg. On March 1, 1916, he was appointed shop foreman at Kenora; on March 11, 1919, night locomotive foreman; on June 14, 1919, shop foreman; on August 12, 1919, shop foreman at Fort William, Ont.; on January 1, 1922, shop foreman, locomotive shop, Winnipeg; on September 17, 1923, locomotive foreman, North Transcona, Man.; on December 27, 1923, shop foreman, locomotive shop, Winnipeg; on March 18, 1924, locomotive foreman, Broadview, Sask.; on March 28, 1924, shop foreman, Winnipeg; on October 24, 1926, locomotive foreman, North Transcona; on December 16, 1926,

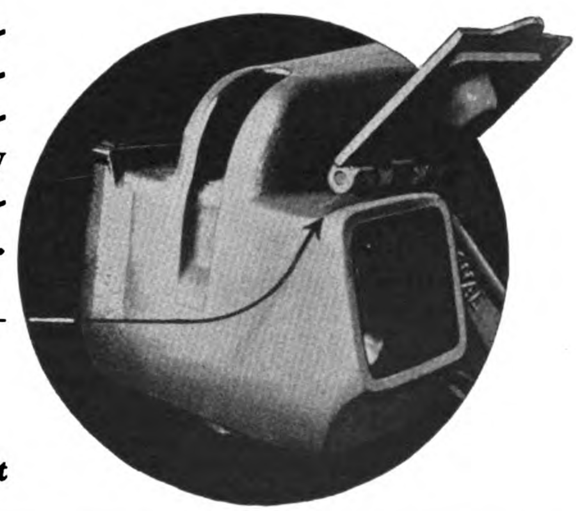
For Replacement On Arch Bar Trucks

NATIONAL Side Frames and Bolsters



made to the latest A.A.R. Specifications . . . Provide greater safety and reduce maintenance expense at *No Additional Cost.*

Brake Beam Supports cast integral, provide additional brake safety and reduce number of accidents.



Journal Box Water Ledge — Keeps out water and dirt and reduces number of hot boxes.

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General Offices: CLEVELAND, OHIO

Sales Offices: New York, Philadelphia, Chicago, St. Louis, San Francisco.
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shop foreman, locomotive shop, Winnipeg; on September 25, 1927, locomotive foreman, North Transcona; on January 1, 1928, shop foreman, locomotive shop, Winnipeg; on September 1, 1928, locomotive foreman, Medicine Hat, Alta.; on July 1, 1932, locomotive foreman, Winnipeg; on March 15, 1935, division master mechanic, Calgary, and on January 16, 1937, division master mechanic, Edmonton.

C. W. Whistler, enginehouse foreman of the Pennsylvania, has been appointed assistant master mechanic of the Maryland and Baltimore divisions.

R. J. MacNamara, assistant road foreman of engines and assistant trainmaster of the Wilkes-Barre division of the Pennsylvania, has been appointed assistant road foreman of engines and assistant trainmaster of the Monongahela division.

F. D. Veazey, general foreman of the Norfolk & Western at Columbus, Ohio, has been appointed to fill the newly created position of assistant master mechanic of the Radford and Shenandoah divisions, with headquarters at Shaffers Crossing, Roanoke, Va.

Car Department

J. O'Neal, general car foreman of the Gulf, Mobile & Northern, has been appointed superintendent of the car department, with headquarters as before at Mobile, Ala.

E. Y. Nitrauer, division car foreman on the Erie at Marion, Ohio, has been appointed shop superintendent of the Port Jervis (N. Y.) car shop, to succeed M. H. Quinn, who has retired.

Shop and Enginehouse

Arthur D. O'Neill has been appointed chief boiler inspector of the Pere Marquette, with headquarters at Grand Rapids, Mich.

A. R. Reed, assistant night enginehouse foreman of the Chesapeake & Ohio at Hinton, W. Va., has been appointed night enginehouse foreman, vice P. T. Briers.

P. T. Briers has been appointed general foreman of the Chesapeake & Ohio, with headquarters at Charlottesville, Va., succeeding J. S. Williams.

A. G. Gebhardt, general foreman of the Illinois Central at Twenty-seventh street, Chicago, has been appointed general foreman at Markham yard, Chicago, succeeding J. N. Fox.

J. O. Green has been appointed superintendent of the Frascati shops of the Gulf, Mobile & Northern and will have jurisdiction over both locomotive and car departments, with headquarters at Mobile, Ala.

Howard S. West, enginehouse foreman of the Illinois Central at Centralia, Ill., has been appointed general foreman of the enginehouse at Twenty-seventh street, Chicago, succeeding A. G. Gebhardt.

H. C. Wyatt, assistant road foreman of engines of the Pocahontas division of the Norfolk & Western, at Bluefield, W. Va., has been promoted to the position of general foreman, with headquarters at Columbus, Ohio, succeeding F. D. Veazey.

Frank Bernard Downey, who has been appointed assistant shop superintendent of the Chesapeake & Ohio at Huntington, W. Va., as noted in the April issue of the *Railway Mechanical Engineer*, was born on September 30, 1890, at Huntington. He

F. B. Downey

attended high school and Marshall College, entering the service of the C. & O. on October 1, 1907. After serving as a machinist on the C. & O. and other roads, he became assistant enginehouse foreman of the C. & O. at Russell, Ky., on October 1, 1918. On October 1, 1919, he became enginehouse foreman, and on October 1, 1920, general foreman. On October 1, 1924, he was transferred to Covington, Ky., as general foreman; on October 1, 1925, became general foreman at Huntington, and on March 1 of this year assistant shop superintendent.

Obituary

Charles D. Powell, boiler foreman of the Baltimore & Ohio at Grafton, W. Va., died on February 2 following a stroke.

B. B. Cleaton, assistant division master mechanic of the Louisville & Nashville, with headquarters at Loyall, Ky., died on March 25.

Joseph H. Nash, who resigned in 1930 as superintendent of motive power of the Illinois Central, died at his home at Chicago on April 14 after a long illness.

Jacob E. Mechling, formerly superintendent of motive power on the Pennsylvania, with headquarters at Indianapolis, Ind., died at this home in Indianapolis on April 15. Mr. Mechling retired in 1925.

Franklin E. Cooper, superintendent of shops of the Baltimore & Ohio at Butler, Pa., died on February 7. Mr. Cooper was born at Connersville, Pa., on October 22, 1882. He entered railroad service as a machinist apprentice on the Pittsburgh & Lake Erie at Pittsburgh, Pa. Upon the completion of his apprenticeship in 1910 he became machine shop foreman and apprentice instructor. In 1916 he became general foreman of the Baltimore & Ohio at Newark, Ohio, where he worked his way up to the position of master mechanic. In 1924 he was appointed superintendent of shops at Glenwood, Pa.; five years later was transferred to Gassaway, W. Va., and in 1934 became superintendent of shops at Keyser, W. Va., where he had charge of both locomotive and car departments. On January 14 of this year he was transferred to Butler.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

Hasler Speed Indicator.—The Hasler Speed Indicator, a precision instrument for measuring machine speeds, is illustrated and described in the eight-page bulletin issued by the Hasler-Tel Company, 461 Eighth avenue, New York.

Bolts and Nuts.—Bulletin No. 16, issued by the Dardelet Threadlock Corporation, 205 W. Wacker Drive, Chicago, illustrates and describes Dardelet self-locking bolts and nuts for application particularly where vibration, shock and similar stresses are encountered.

J-Metal Cutting Tools.—The Haynes Stellite Company, a unit of the Union Carbide and Carbon Corporation, Kokomo, Ind., has issued a 52-page booklet describing the properties and economies of J-Metal and presenting data on the recommended procedures for its use. A section on Haynes Stellite welding rod describes the advantages derived from hard-facing wearing parts of machine-shop equipment.

Easy-Flo Brazing Alloy.—Easy-Flo, a brazing alloy which works equally well on both ferrous and non-ferrous metals—stainless steel, monel metal, chrome-nickel and copper-nickel alloys, etc.—is described in the four-page bulletin issued by Handy & Harman, 82 Fulton street, New York.

Landis Check Book.—"Bank on Landis for Savings" is the title of the unique book of threading costs and production records issued by The Landis Machine Company, Waynesboro, Pa., for users of thread cutting and tapping equipment. Each "check" in the book is numbered and, for each job, gives the name of part; equipment and material used; material hardness; production; cutting speed, etc. Should additional data be desired, the check stub with the corresponding job number can be filled in and sent to the Landis Company.

Railway Mechanical Engineer

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AGATHON* NICKEL IRON

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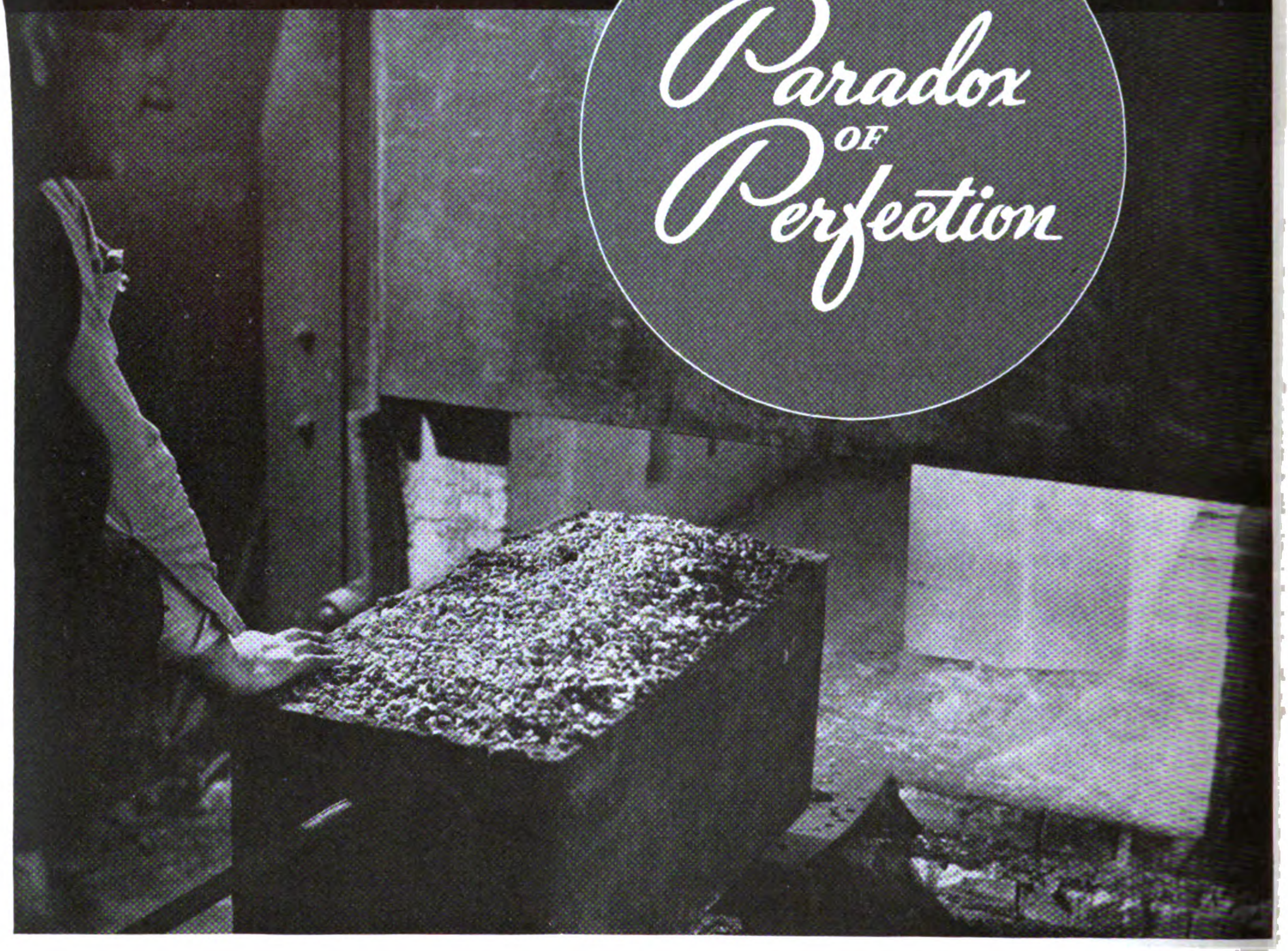

HARD as glass on the surface to provide long-wearing life, yet with an interior toughness that resists shock—these conflicting qualities must be combined for long, economical service from locomotive pins and bushings. » » » Case-hardened parts of Agathon Nickel Iron present a uniform, hard surface free from slag pockets — a surface that lubricates perfectly and resists wear. The inner core has high shearing strength and high resistance to shock which means greater useful strength. » » » Heat treatment is easy and inexpensive — simply carburize and quench from the pot without spoiling the surface for smoothness. » » » For continuous, dependable service of case-hardened parts, specify Agathon Nickel Iron. Complete information on request. Address Department RG.

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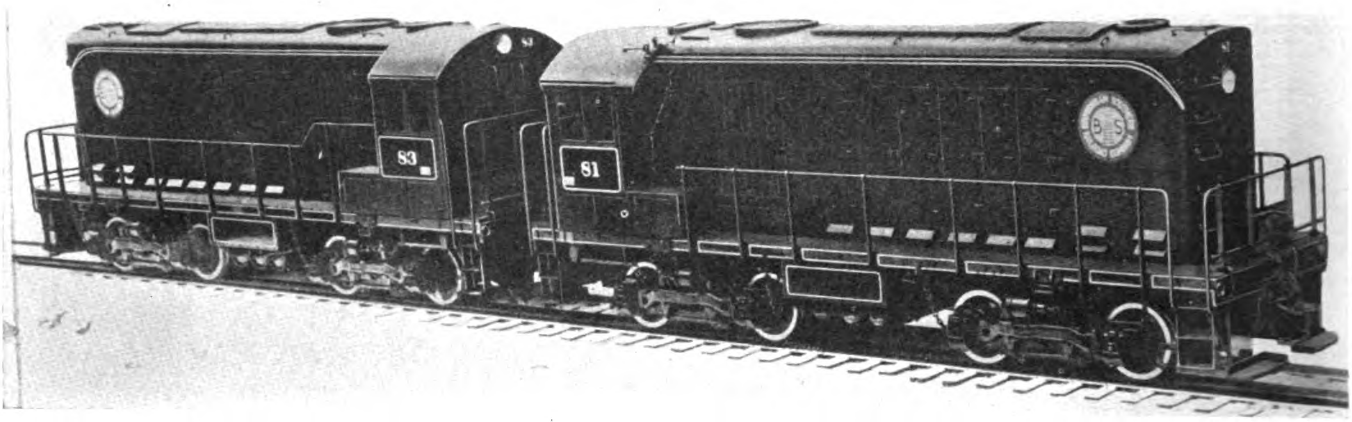
THE NEW ERA OF RAILWAY PROGRESS

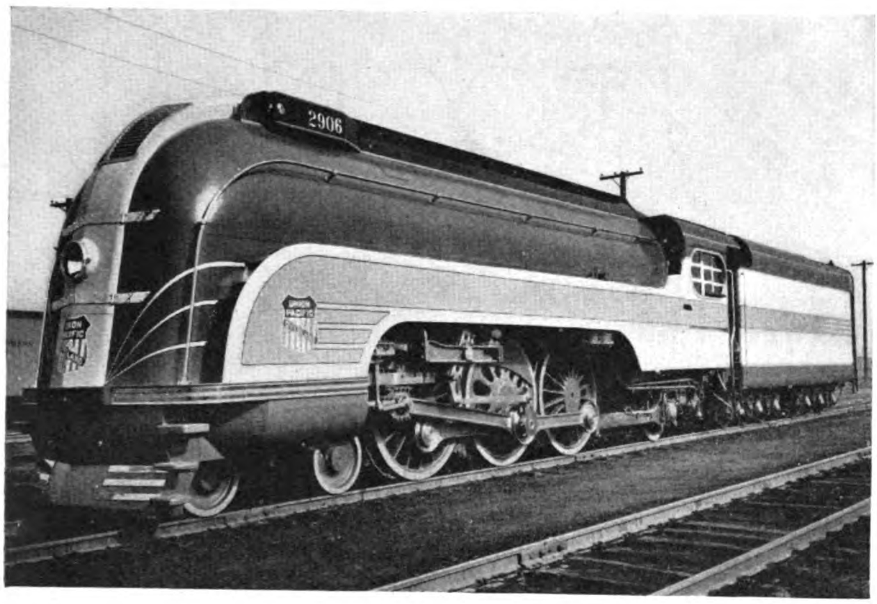
SINCE 1930, when the last Atlantic City exhibit was held, the railroads and the railway supply industries alike have been subjected to a period of severe financial stress. Activities and organizations have been cut down on every hand. The stagnation resulting from drastic curtailments and widespread discouragement was, however, only a surface aspect of the situation. Imagination and initiative continued to function, even though, to a considerable extent, behind closed doors.

The review in the following pages, while not strictly confined to the seven years which have elapsed since 1930, presents some of the more striking aspects of motive-power and rolling-stock developments and repair-shop rehabilitation as they appear in 1937. Many of these developments are the direct result of the introduction of remarkable new engineering materials, changes in technique and adaptations from other fields.

The same freshness of outlook indicated by the trends in motive power and rolling stock are evident in the adaptations to the new conditions which are seen in railway repair-shop reorganizations and the shop re-equipment movement now under way.

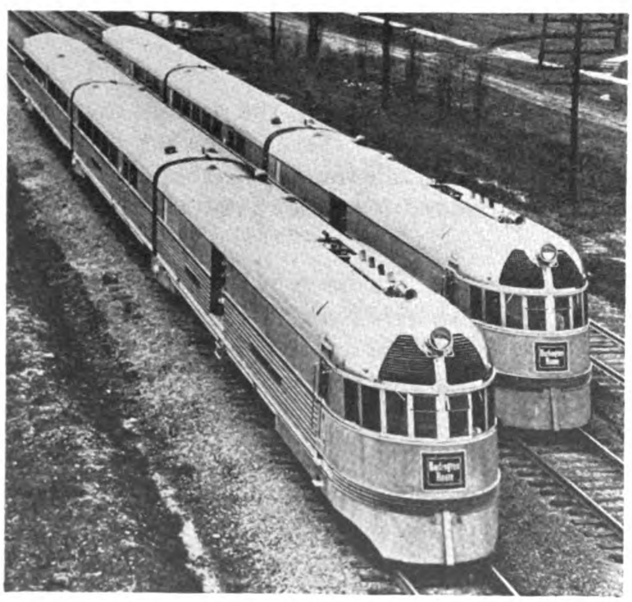
These pages present nothing new. To have one's memory refreshed concerning the accomplishments of a significant period bring its relation to the future into better perspective.

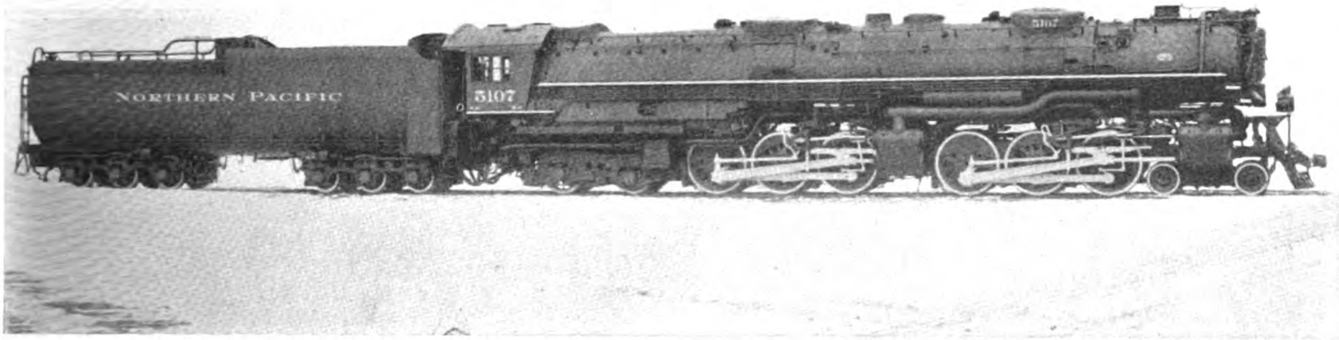




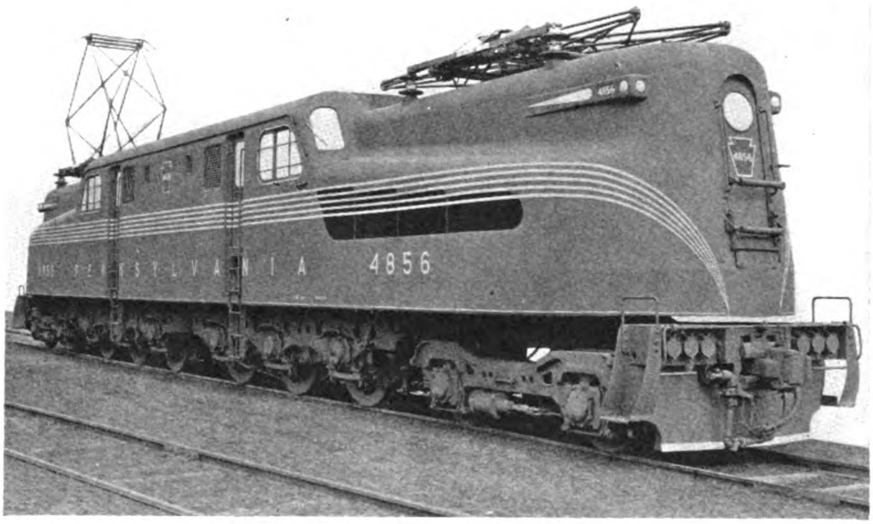
Many Tools Where Once There Was But One!

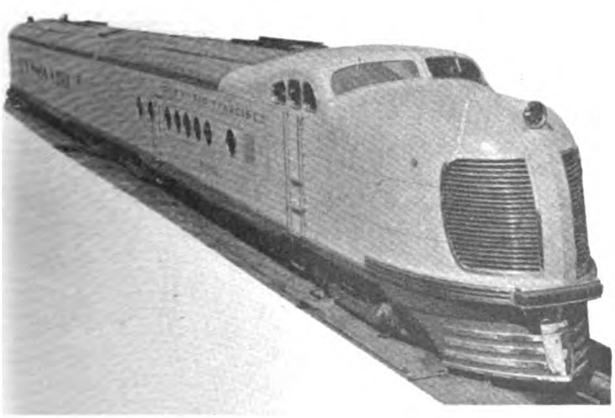
First to share the field with the steam locomotive was electrification; then came the gasoline rail-motor car. This was followed by the Diesel-electric switcher. Articulated Diesel-electric trains and Diesel-electric locomotives for road service were developed during the depression

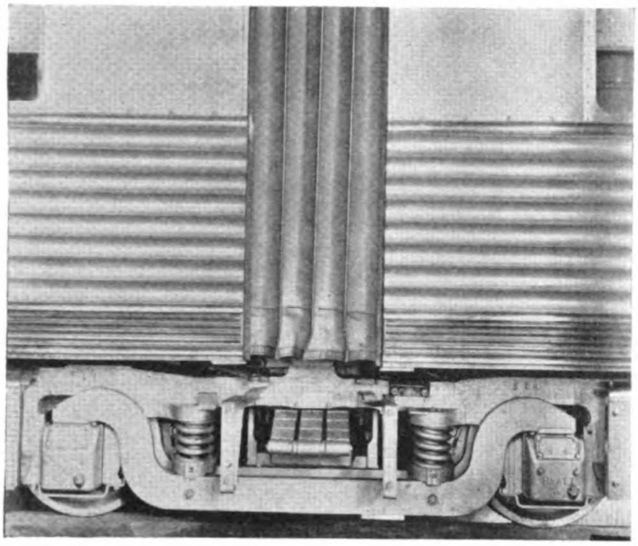


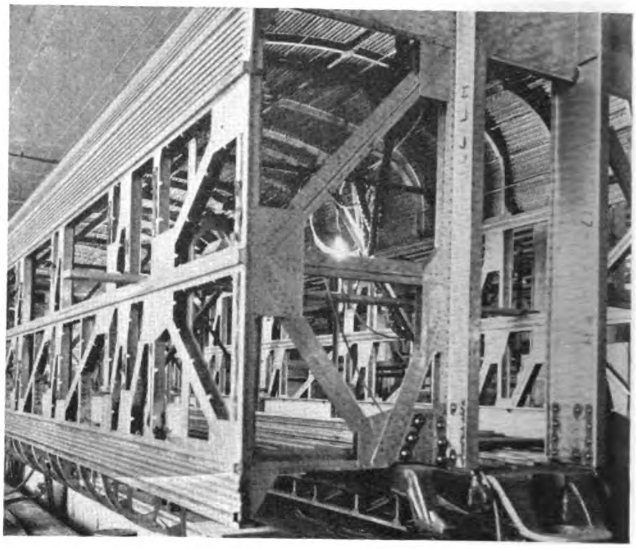


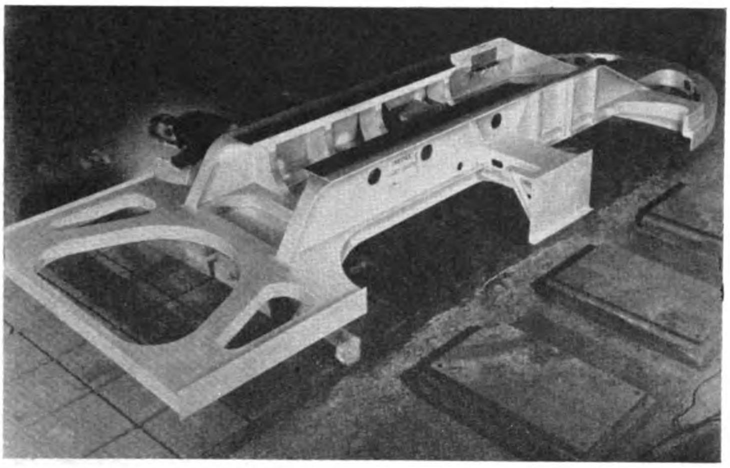
The steam locomotive, which once had the field of heavy traction exclusively to itself, is still the mainstay, relinquishing specialized services to the newer types of power. Style factors introduced with the lightweight Diesel-electric trains have won almost universal acceptance in a matter of three years. Steam locomotives for freight service are growing in tractive capacity as well as in horsepower. The articulated steam locomotive has recently become a high-speed motive-power unit



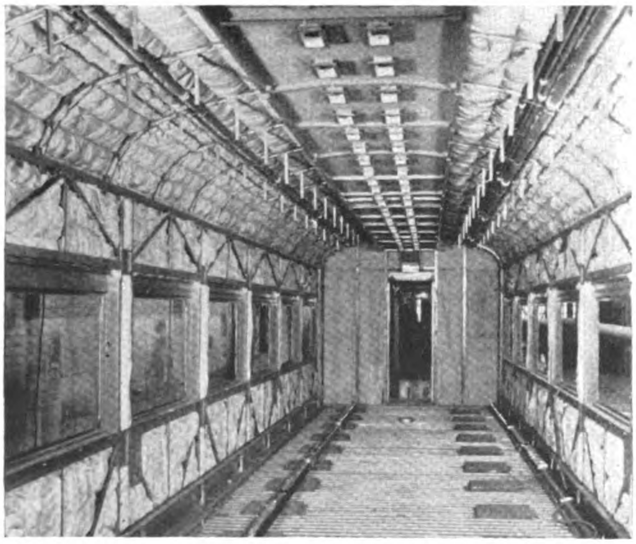


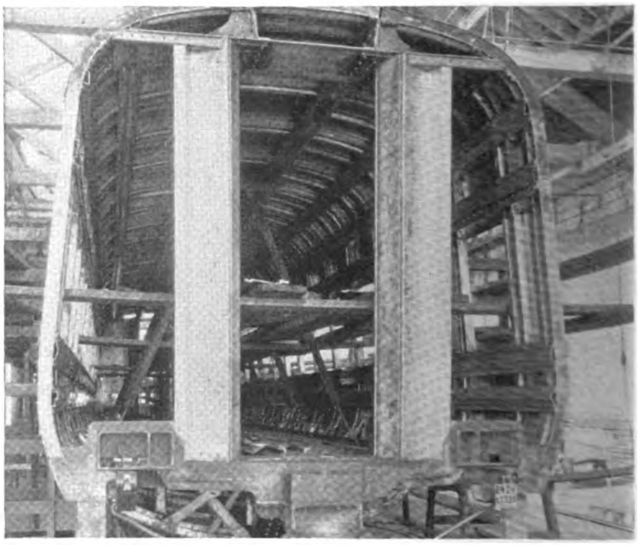


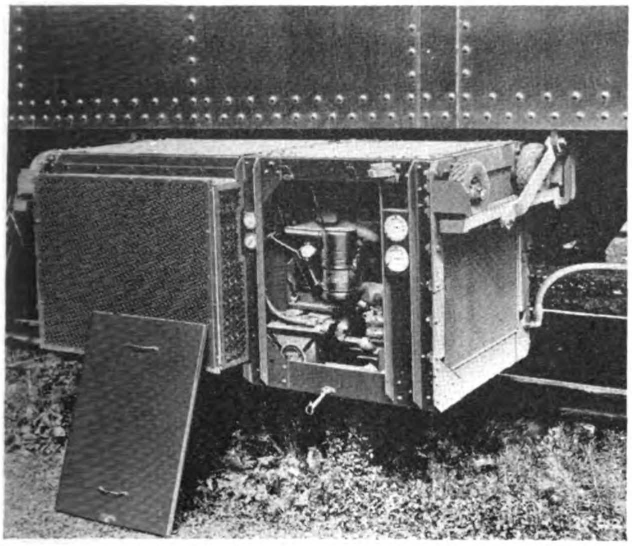


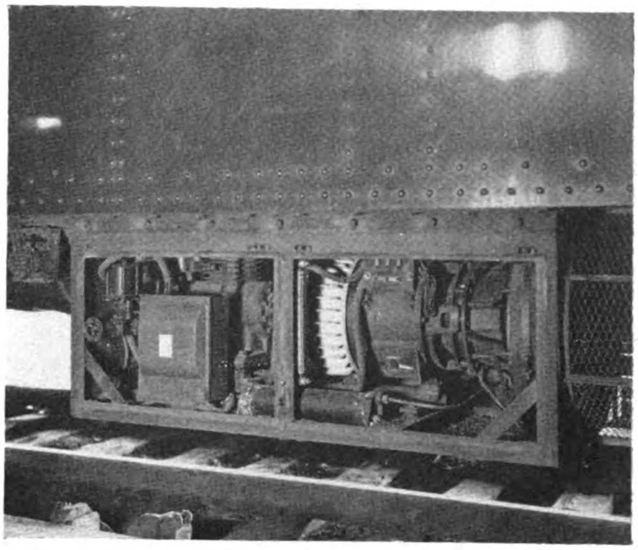


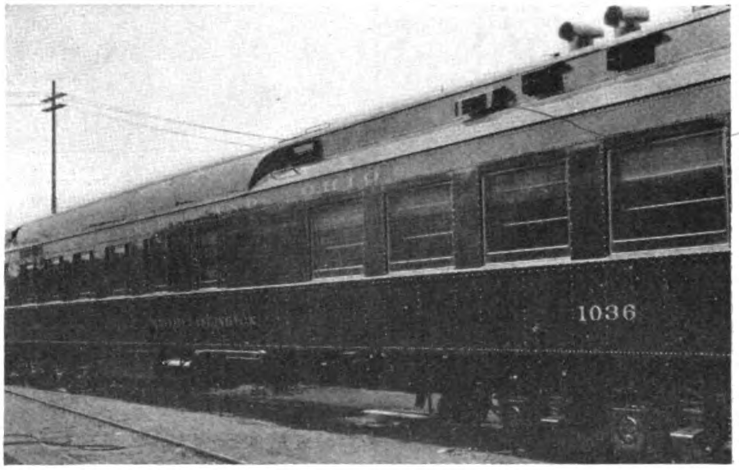
New materials and new techniques—the products of research and engineering development in many industries—are the foundation on which the lightweight streamline trains have been developed. New techniques of construction adapted to the new materials have been evolved. Welding is being increasingly employed. Articulation, rubber cushions, and tight-lock or slack-controlled couplers have contributed to smoother riding qualities. Reduced weight has decreased the demands on motive-power capacity



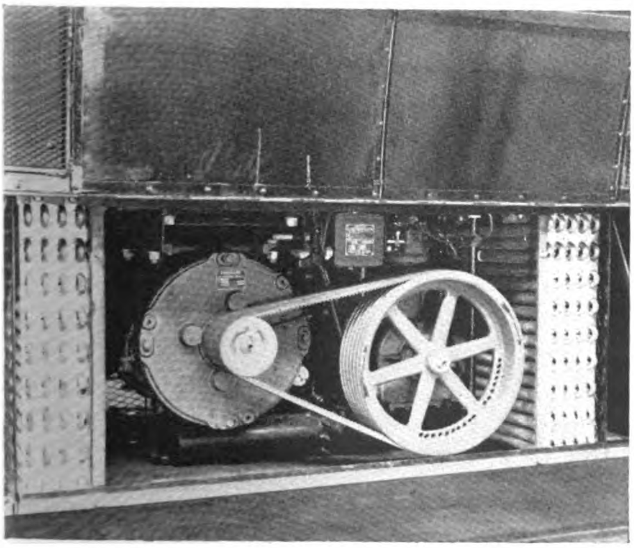


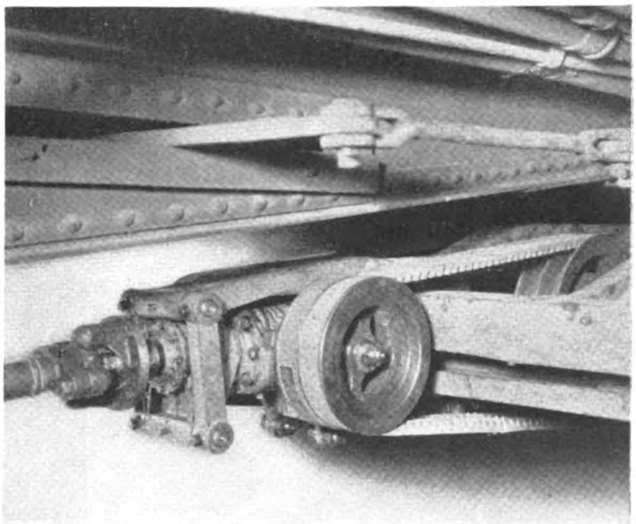


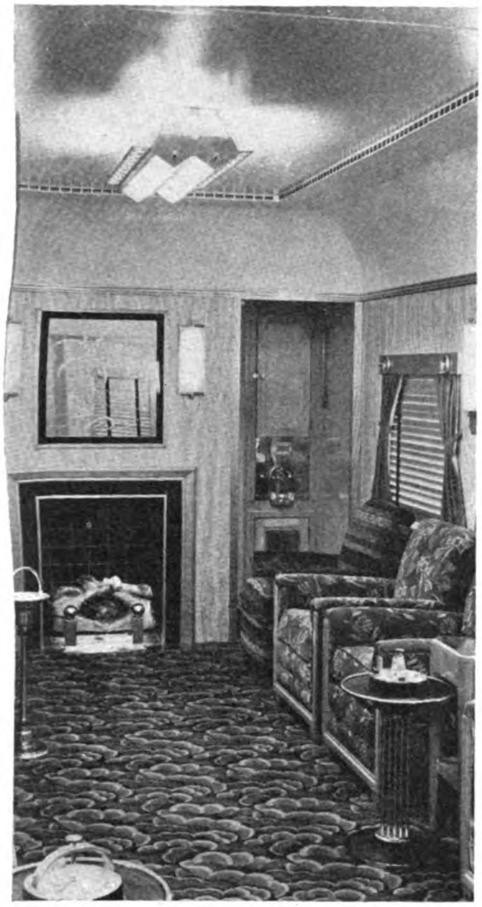




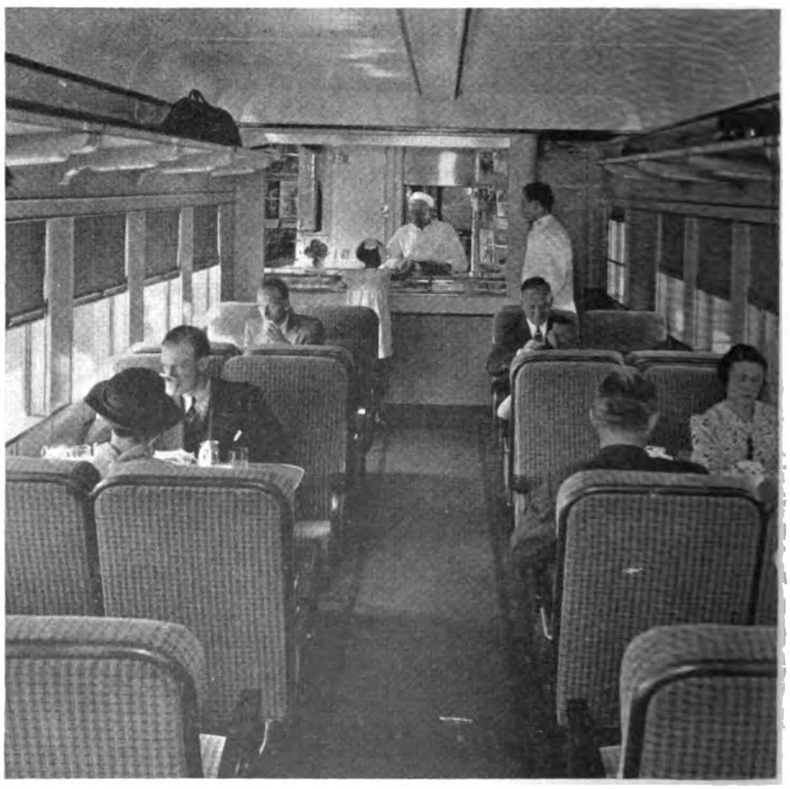
Reduced weight and styled exteriors have been accompanied by a removal of barriers, both psychological and practical, to the interior treatment of passenger cars. Air conditioning, confined to the "Martha Washington" at the time of the 1930 convention, is now applied to 10,000 cars. Aside from its direct influence on summer comfort, its accompanying system of pressure ventilation has removed the former limitations imposed by dirt on interior decorative treatment

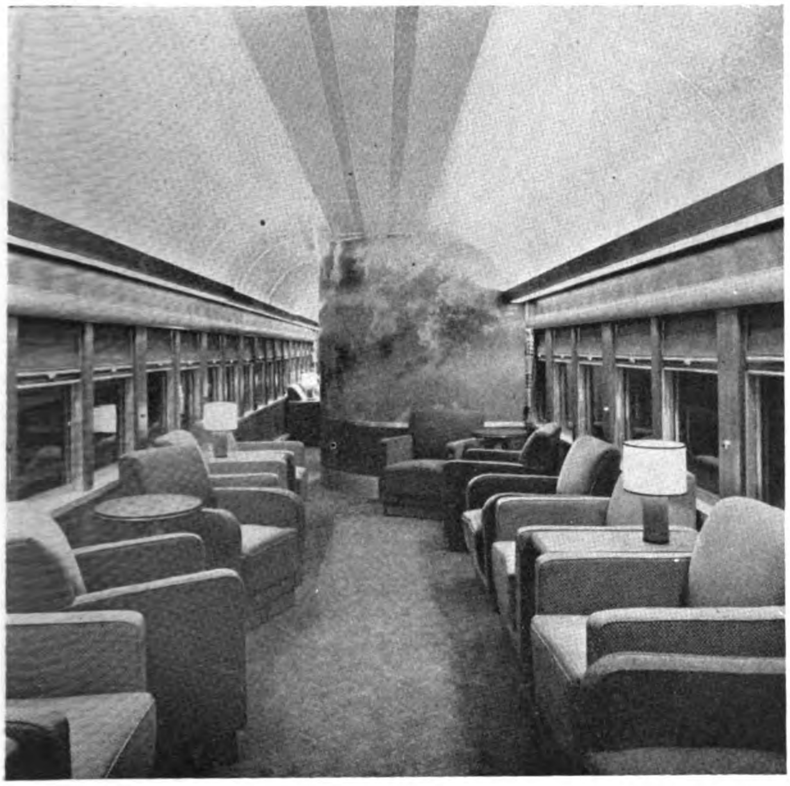


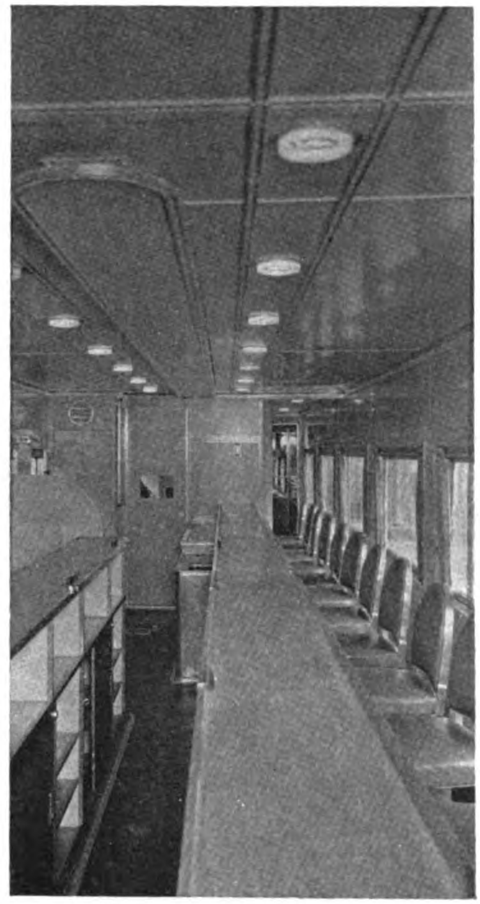




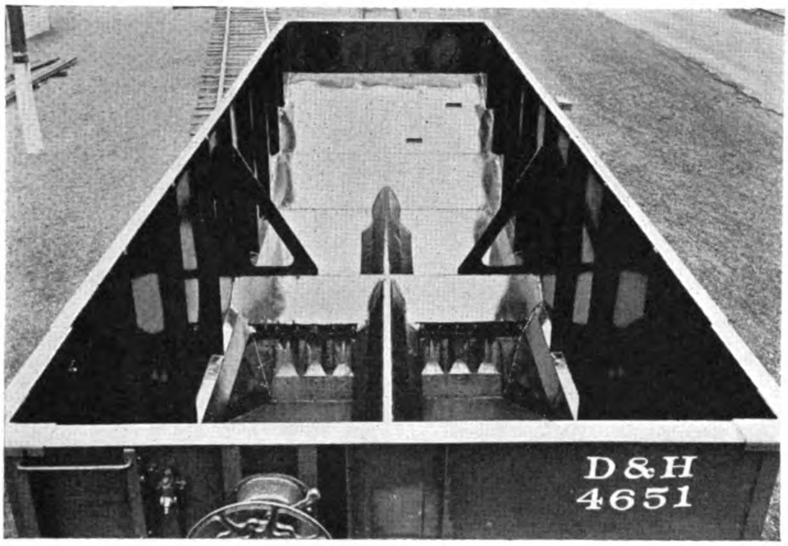
Walls, ceilings, floors—once finished in colors chosen to hide dirt—now run the gamut of shades, strong or pastel, or are finished in beautiful wood surfaces, light or dark, as the decorator chooses. Windows are softened by drapes

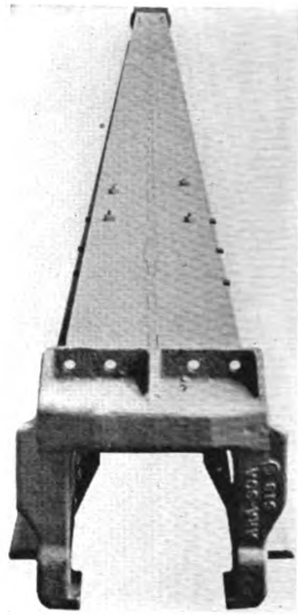


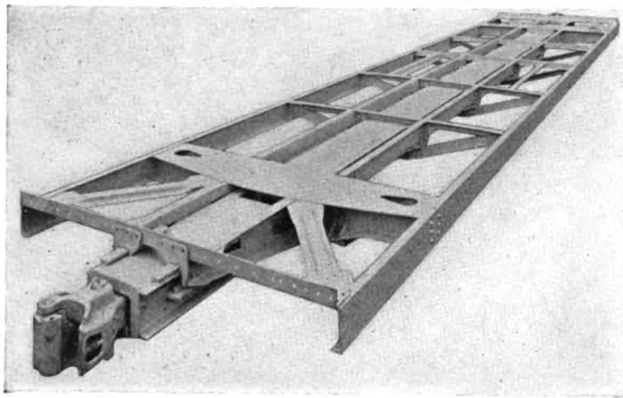




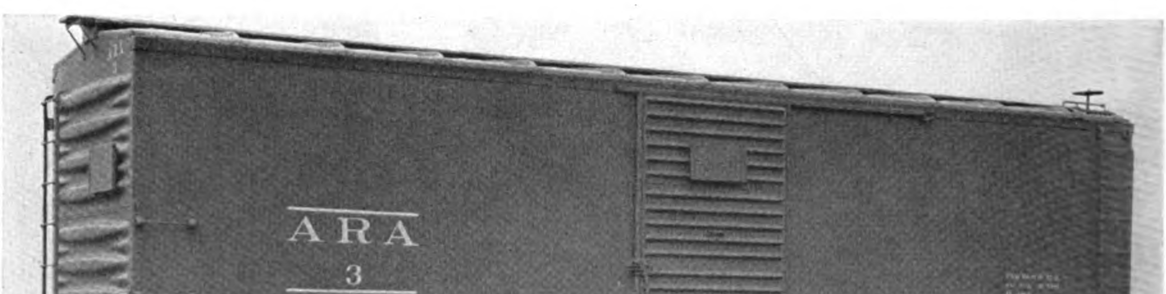
Lower ceilings and varied furniture selections make rooms out of cars. De luxe trains lack little for comfort or pleasure which can be found in the best hotels. Nor are the coach passengers overlooked

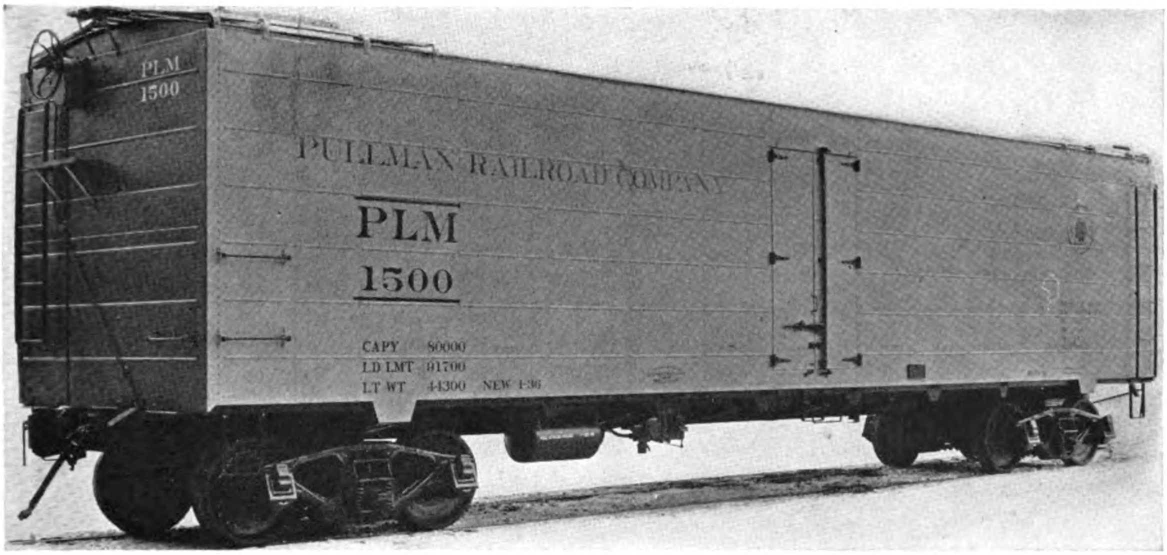


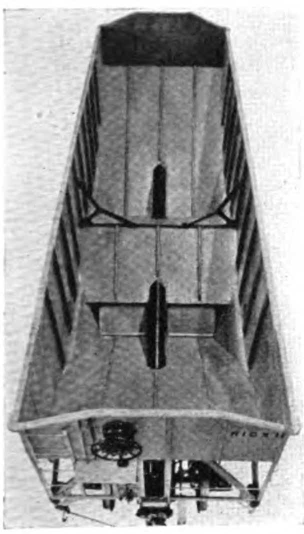




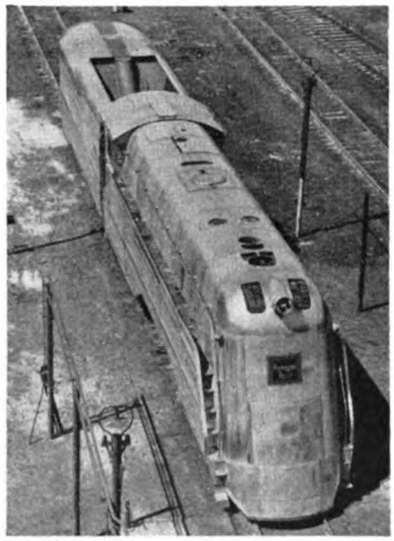
Progress in freight-car design has been no less marked than that in the passenger-car field. The new A.A.R. standard steel-sheathed box car has materially influenced design. Particularly has its center sill received wide acceptance, extending even to passenger cars. The cushion underframe is a growing factor in car construction. Welded construction is being developed by the railroads themselves, as well as by the builders

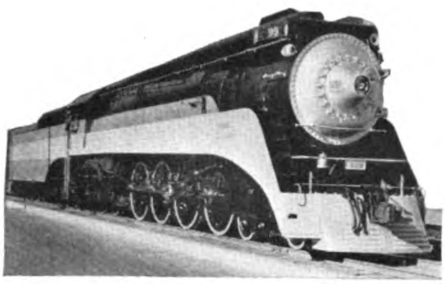




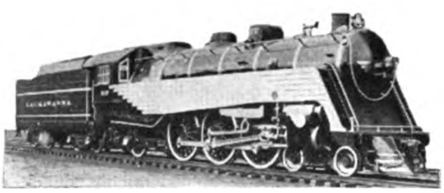


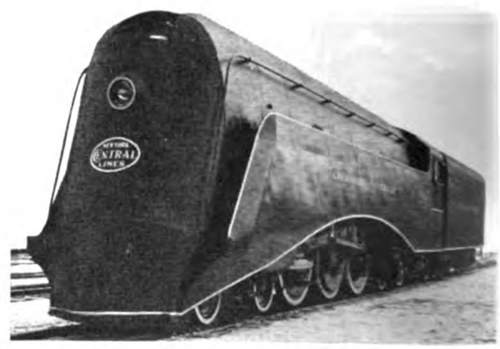
High tensile steels and aluminum alloys have both found their places in the construction of freight cars. The former, with or without welding, are making rapid progress. Cast-steel underframes and steel castings in other parts of the structure are contributing to durability and maintenance-free service

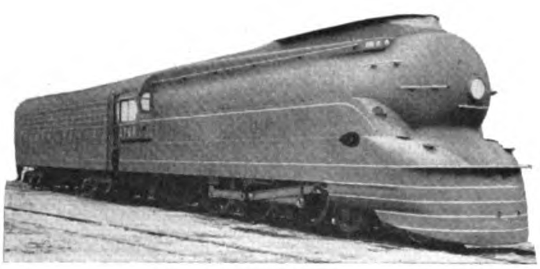


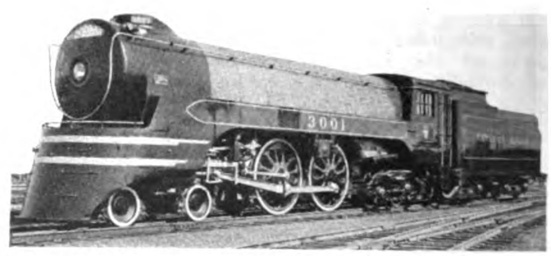


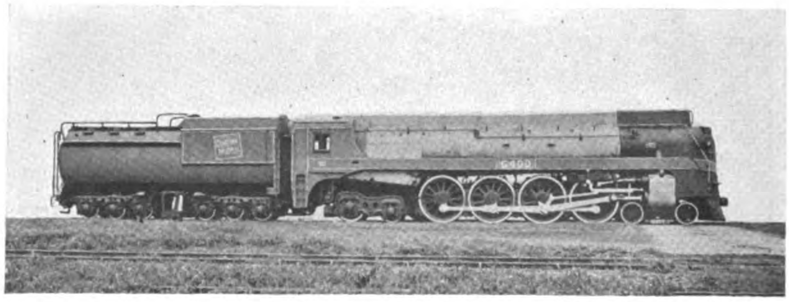
The process of the refinement of the steam locomotive goes on without interruption. The most striking recent development is the adaptation of streamlining. Several independent wind-tunnel investigations show definite possibilities for the reduction of wind resistance by smoother exterior surfaces and improved front-end contours. Not all streamline locomotives, however, are based on aerodynamic principles, although most include special provisions for smoke lifting. All, however, have distinctive style values, strongly appealing to popular fancy

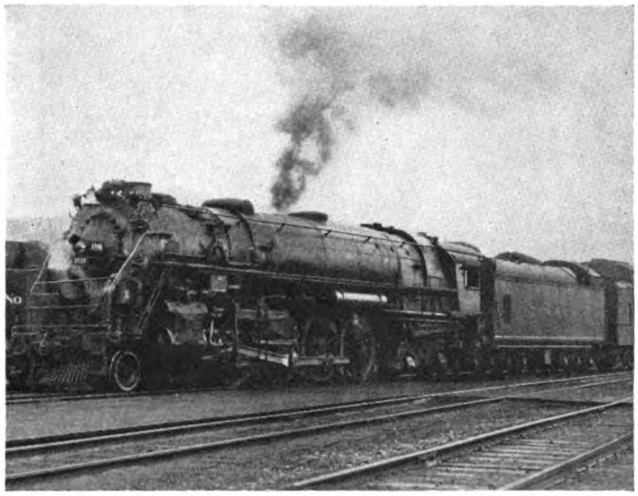


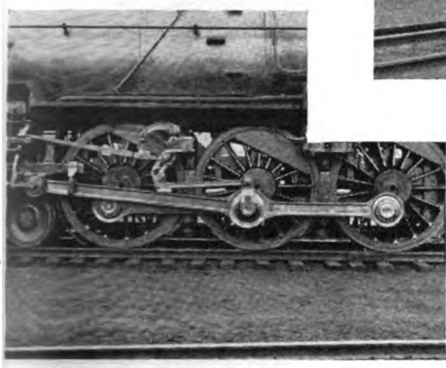


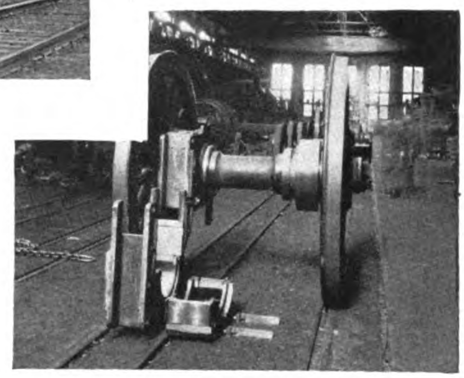


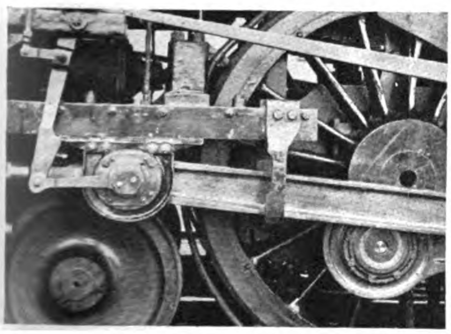


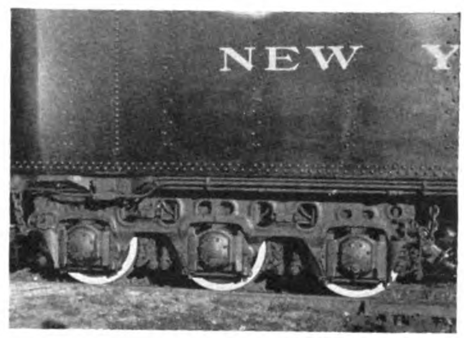




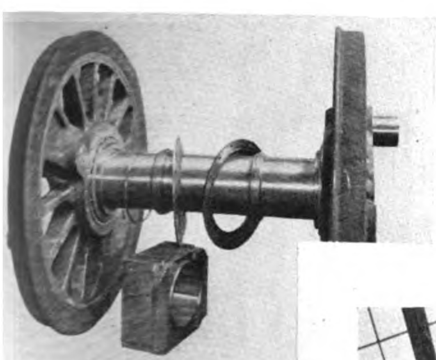


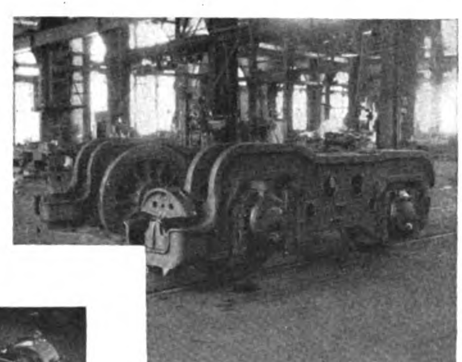


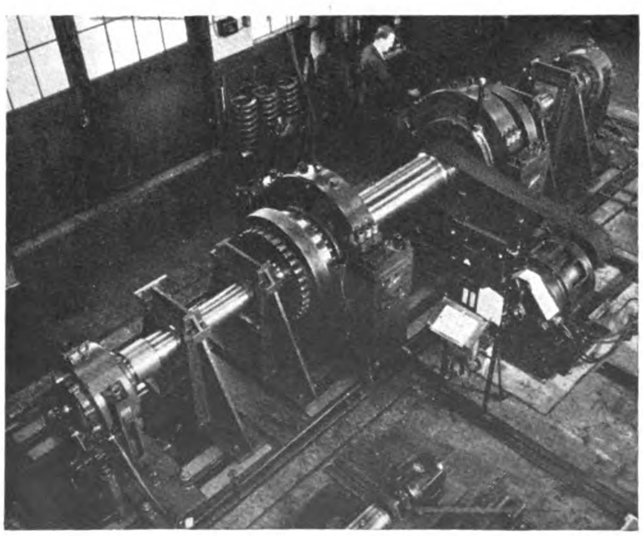


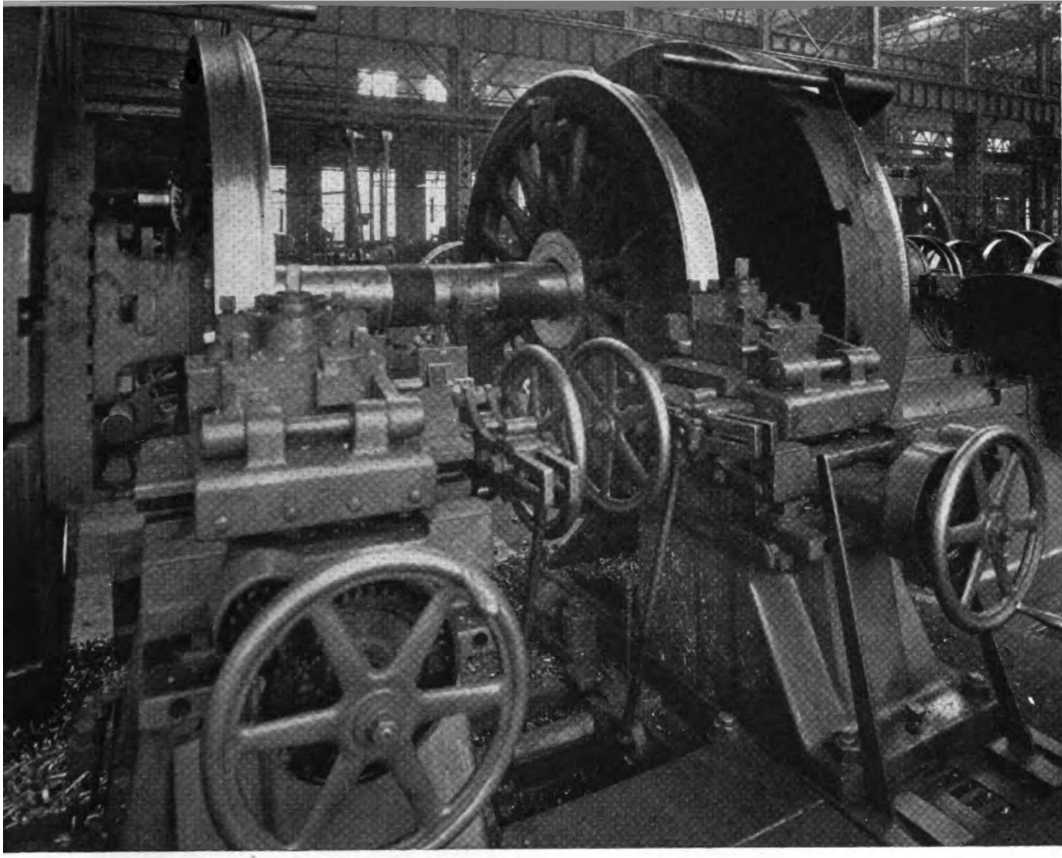


Among the engineering improvements in motive power which have been effected since 1930 the application of roller bearings to locomotive driving axles, crank pins and crossheads takes a leading place. The first locomotives to be completely equipped with roller bearings on all axle journals have now been in service for 500,000 miles. Precision of alignment, infrequent servicing attention and long life are the economic advantages of this major development. Roller-bearing rods, combined with the use of high-tensile steels in rods and reciprocating parts, are promising developments in adapting the steam locomotive to the high speeds demanded in modern passenger service. Research initiated for the adaptation of roller bearings to locomotives continues for increasing the reliability and improving the maintenance-free service of locomotive running gear

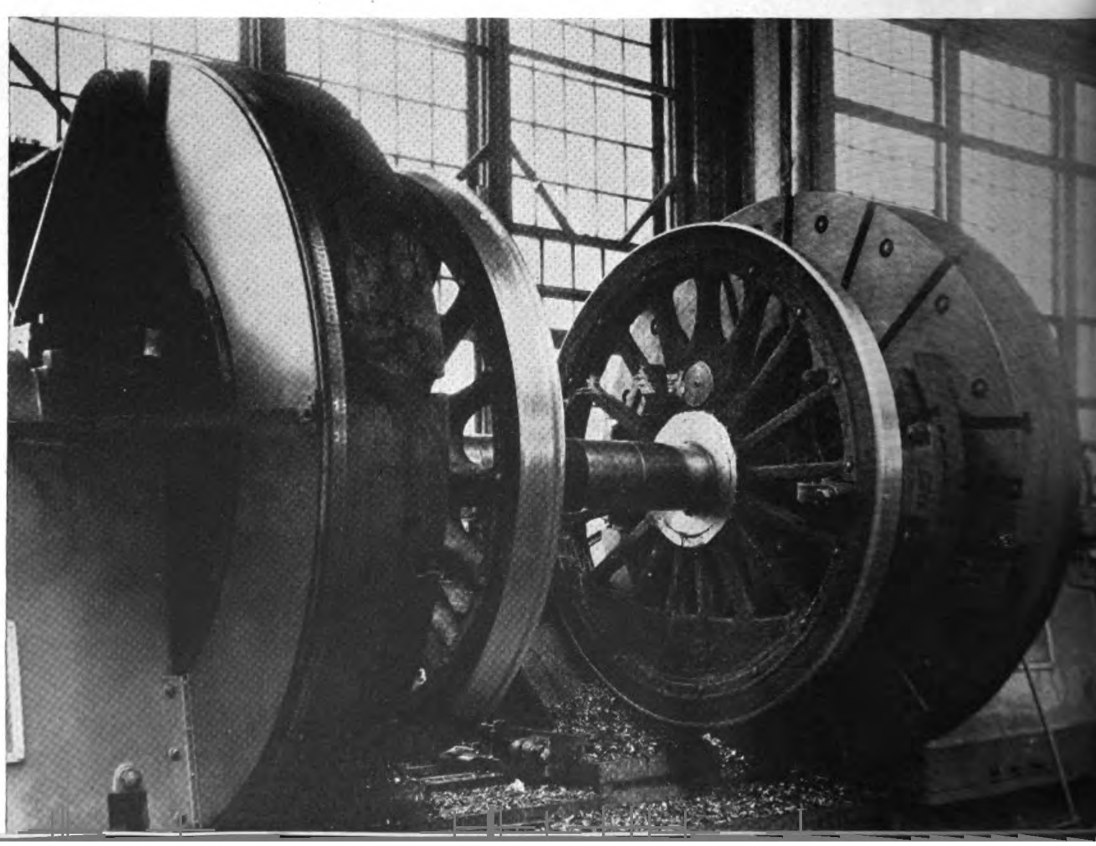


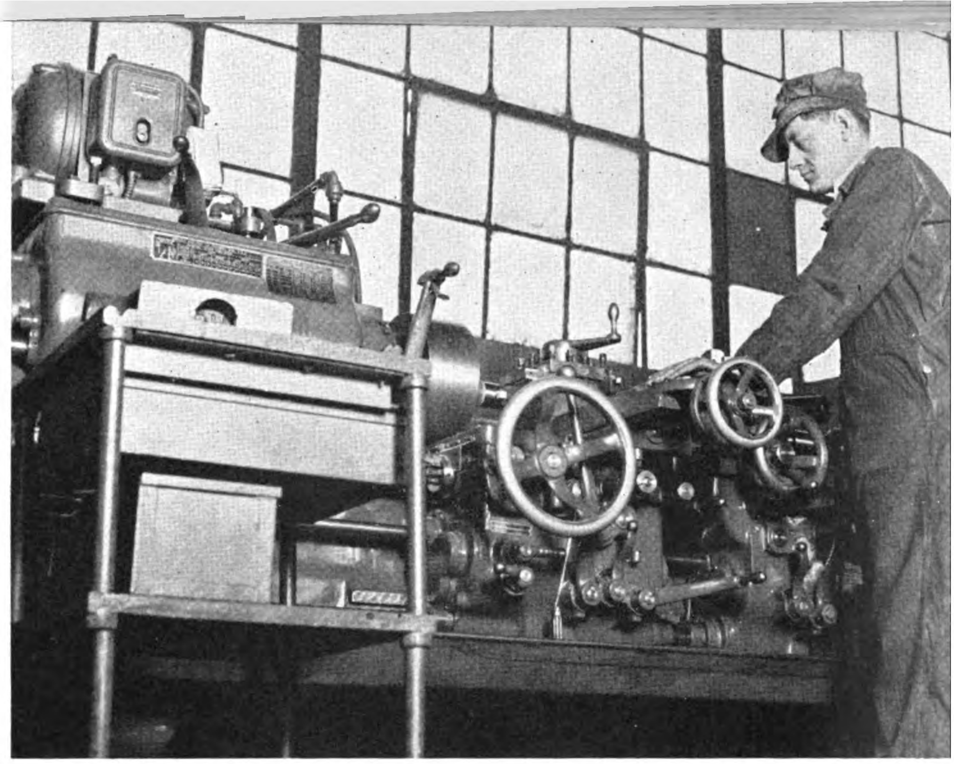




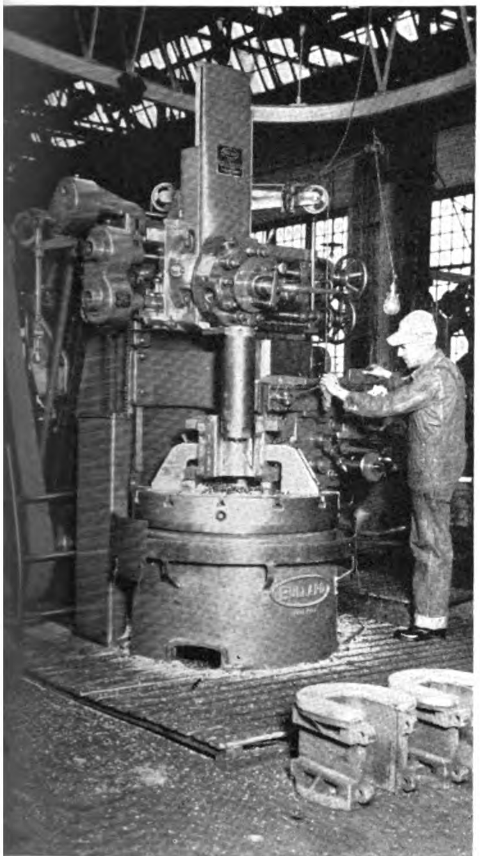


Wheels take on added importance in these days of high-speed train operation. The recognition of the necessity of accurate tire turning has been the influencing factor responsible for the installation of many new driving- and car-wheel lathes during the past two years



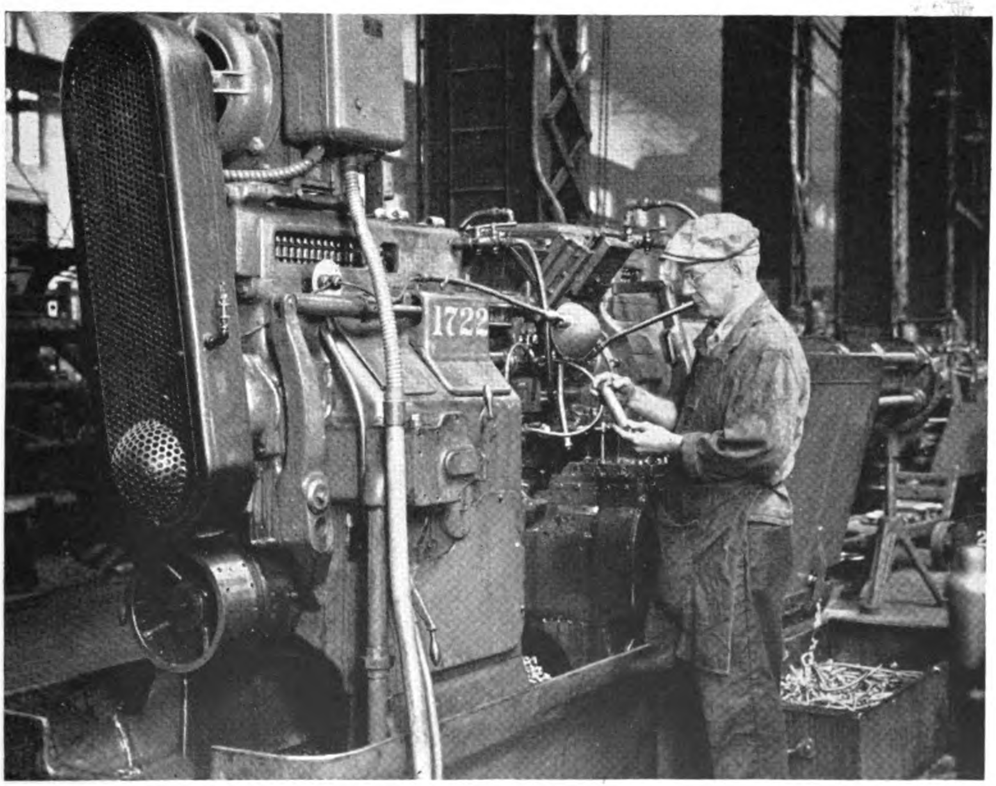


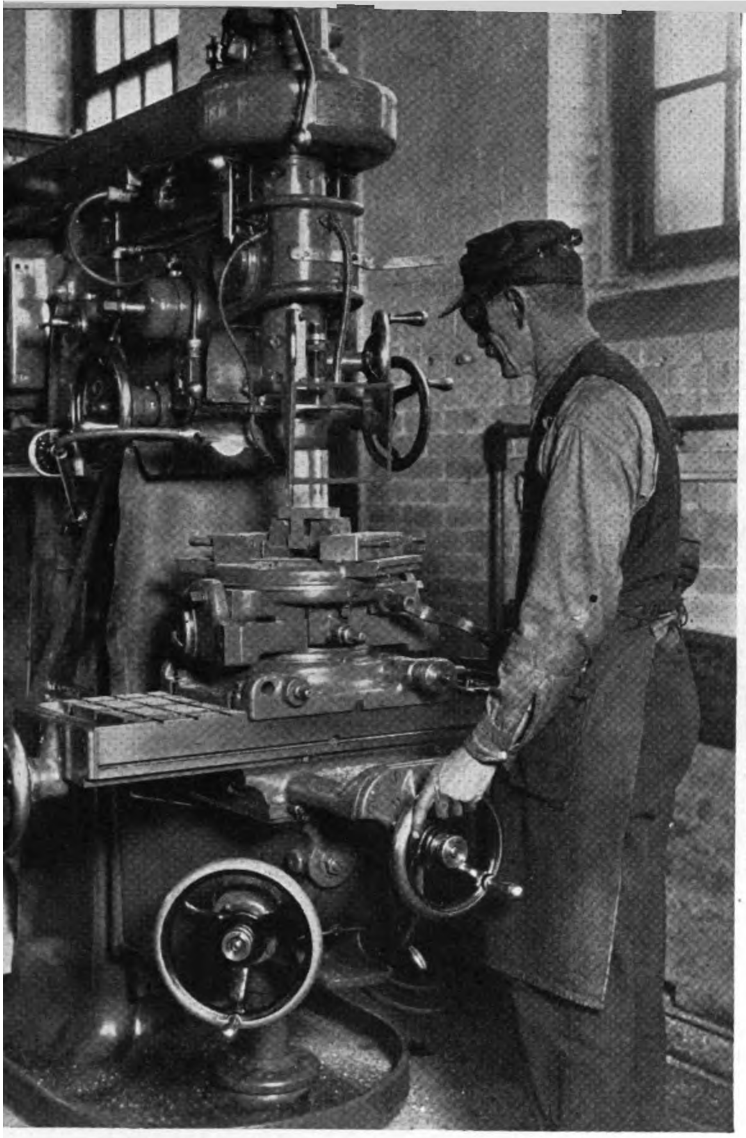
This modern turret lathe, working on a variety of brass and bronze jobs, replaced three old machines



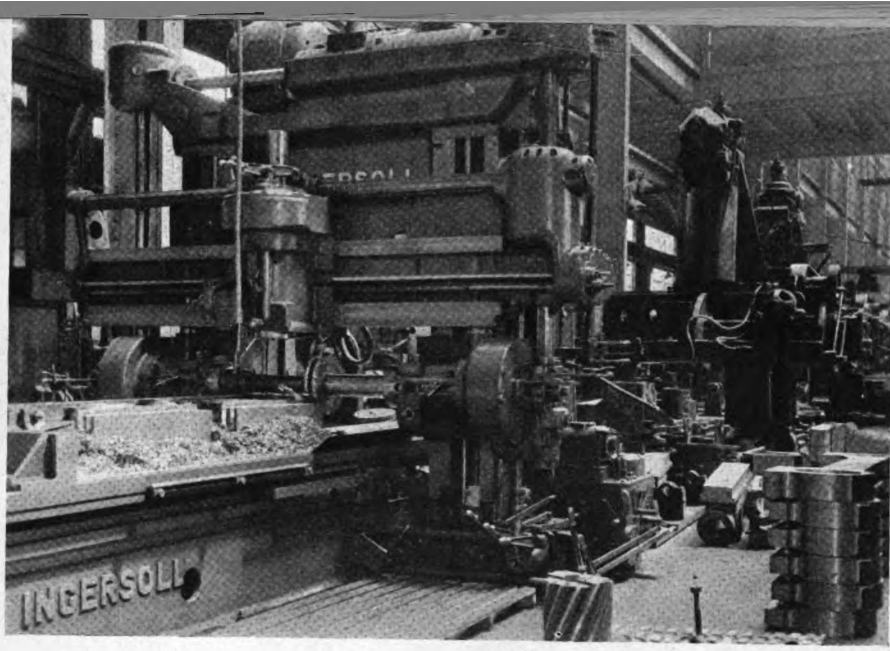
The small shop solves the problem of a special job by equipping a new standard machine with fixtures which broaden the range of use. Here is a machine which is saving 40 per cent on general work

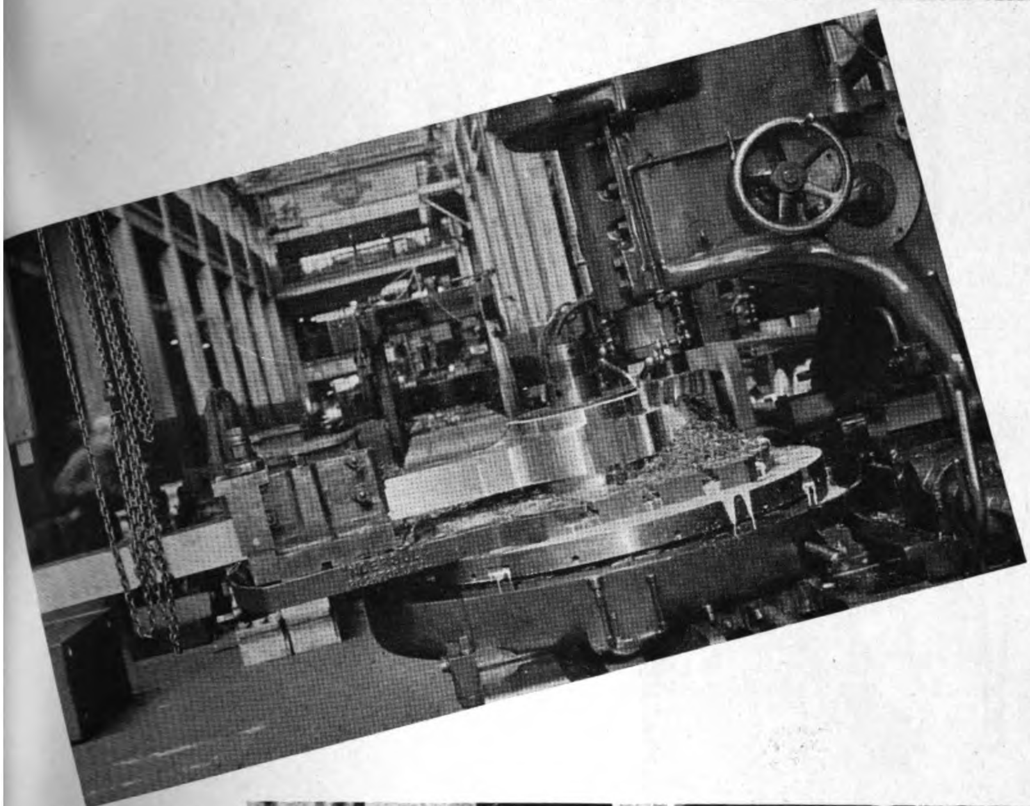
A four-spindle automatic, typical of the machines being used in some large shops for turning out finished pins for locomotives and cars up to 2¼ inches in diameter



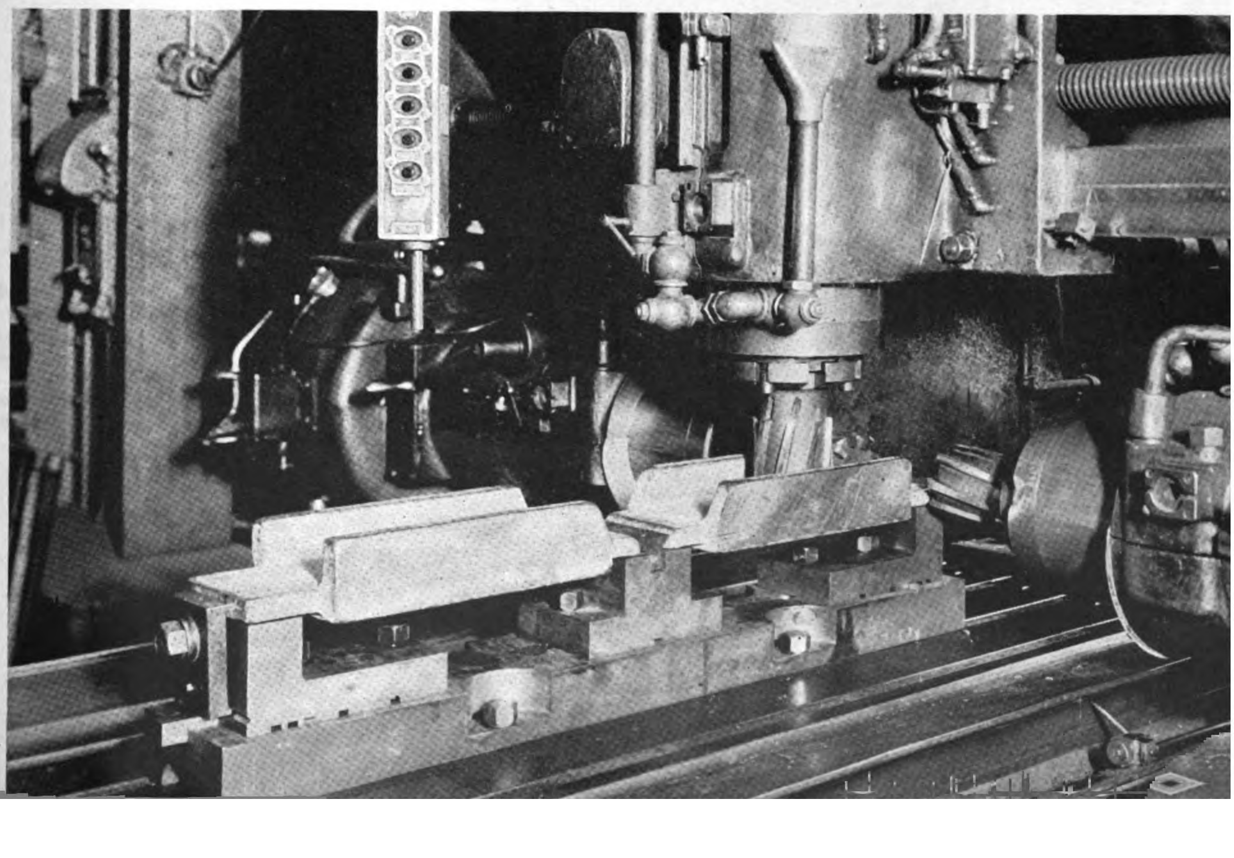


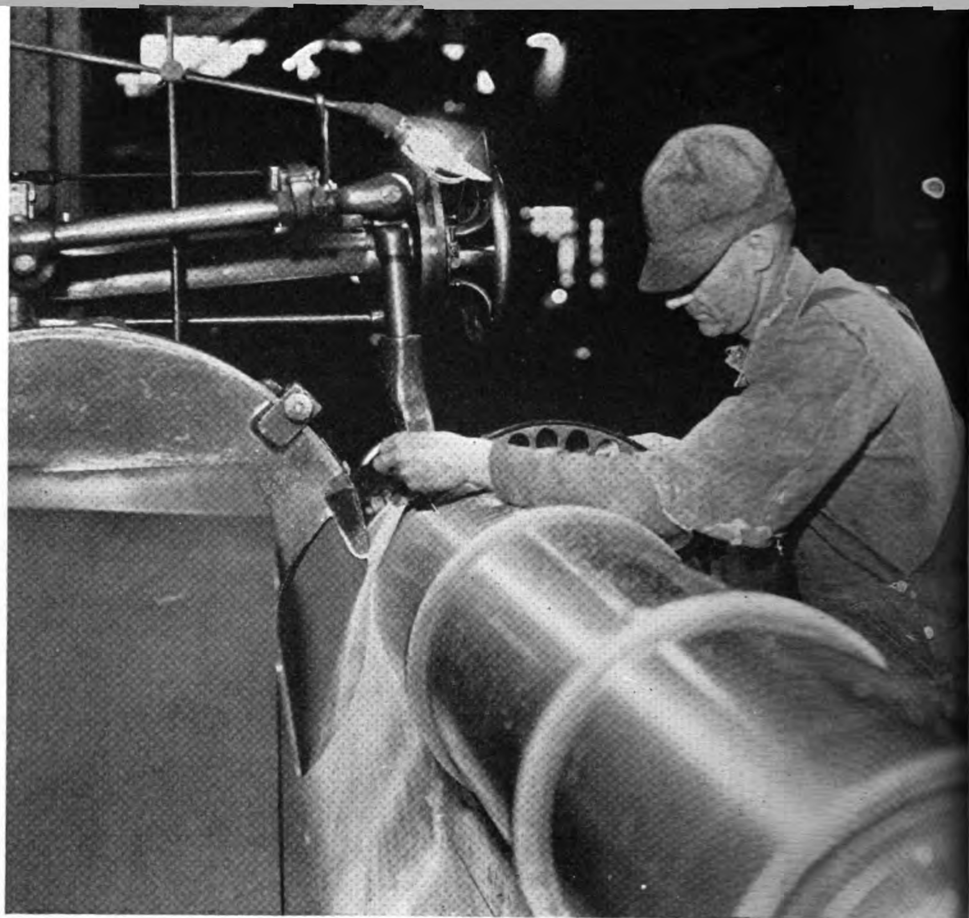
The up-to-date system tool room, such as that shown at the bottom of the page, demands the latest in precision equipment. Typical of the recent installations are the die sinker (at the left) and the electric tool treating furnace (immediately below)





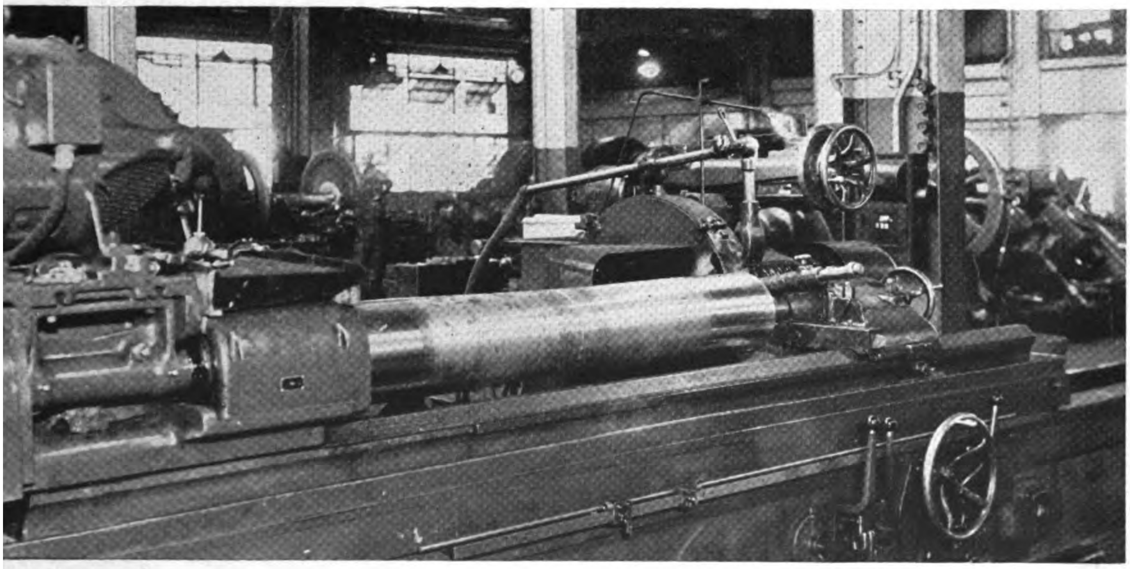
The accurate finishing of locomotive side and main rods, crossheads and shoes and wedges to limits demanded by the requirements of present-day service is a machining problem that is adequately solved by the modern milling machine



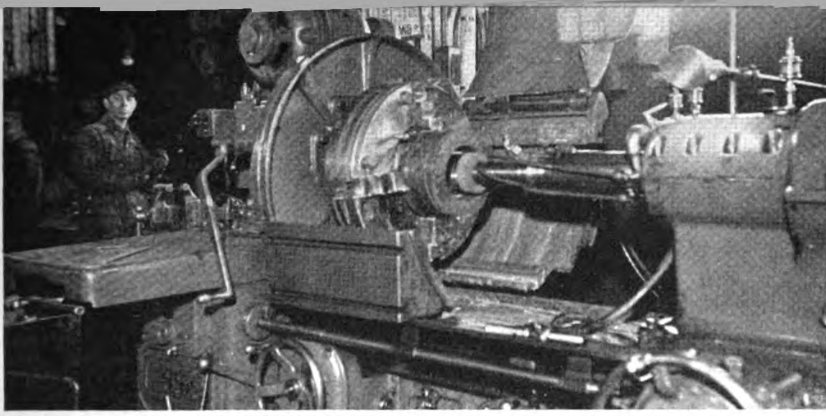


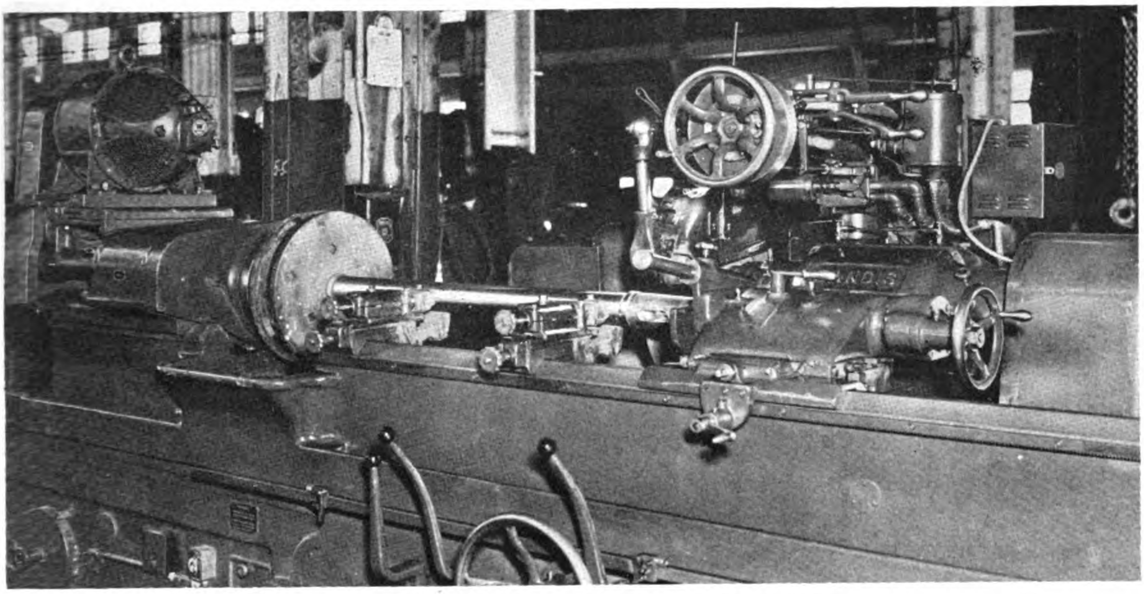
The wide-spread acceptance of roller bearings on locomotive axles has changed railroad machine shop practices. No longer can measurements on a job of this kind (the grinding of an axle tube for roller bearings) be anything but exact — The older machines, with questionable accuracy of production, are giving way to new ones, built to meet today's needs

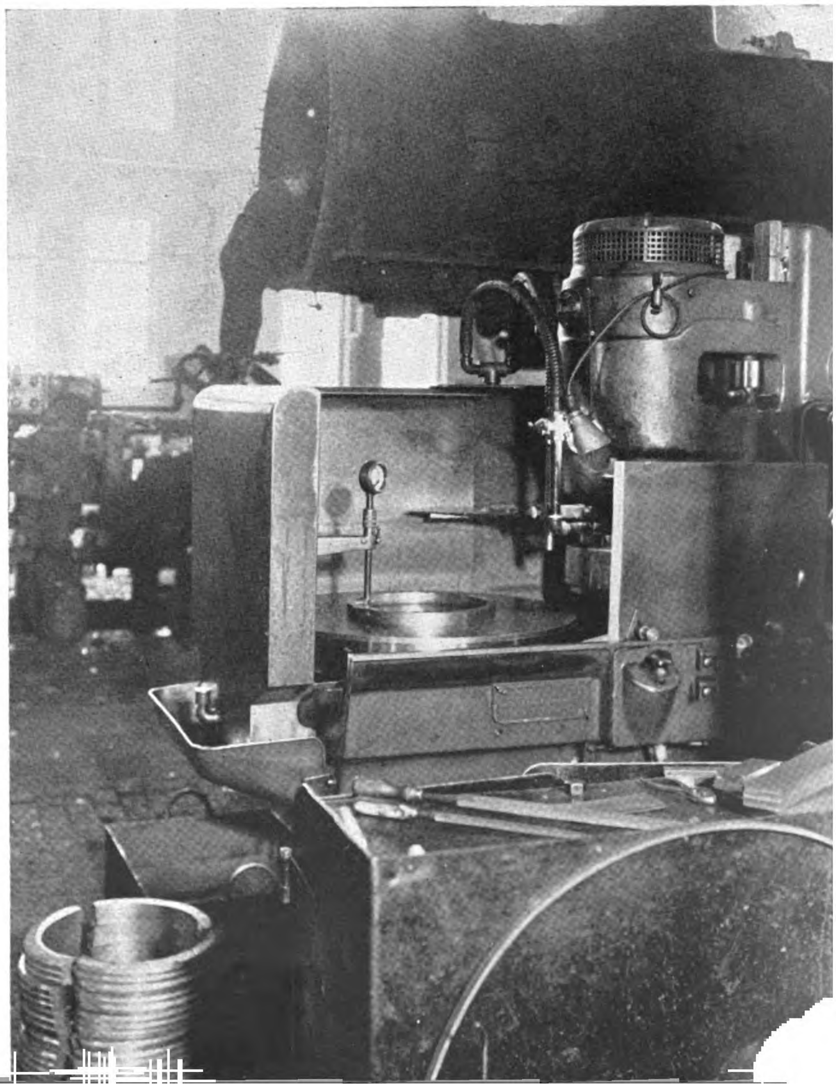
Even on small parts, such as the spring-rigging pins shown going through this centerless grinder at the rate of 50 an hour, the demand for precision is being justified by the greater length of service and lowered cost of equipment maintenance



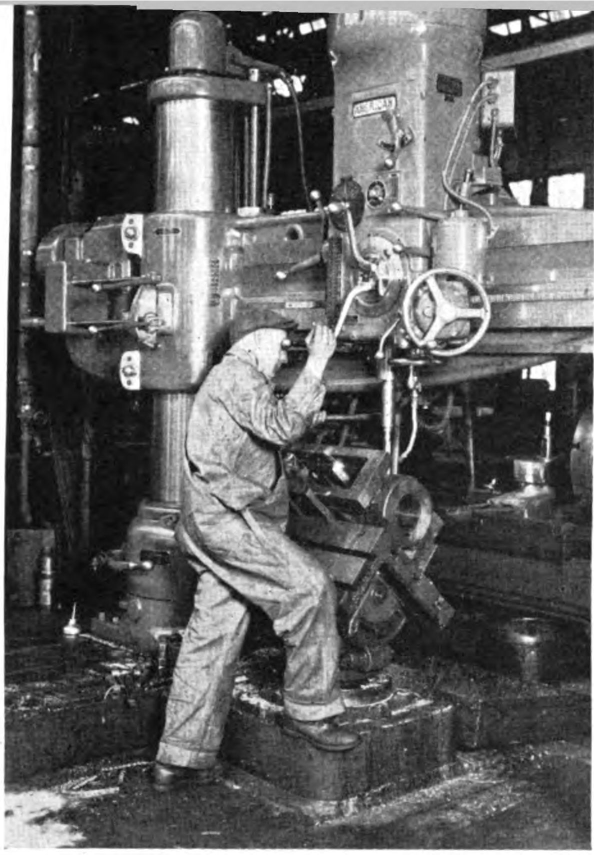
A driving axle, which carries the wheel centers and is assembled inside the axle tube shown at the top of the page, is ground for the wheel fits on the same machine that finishes the tube



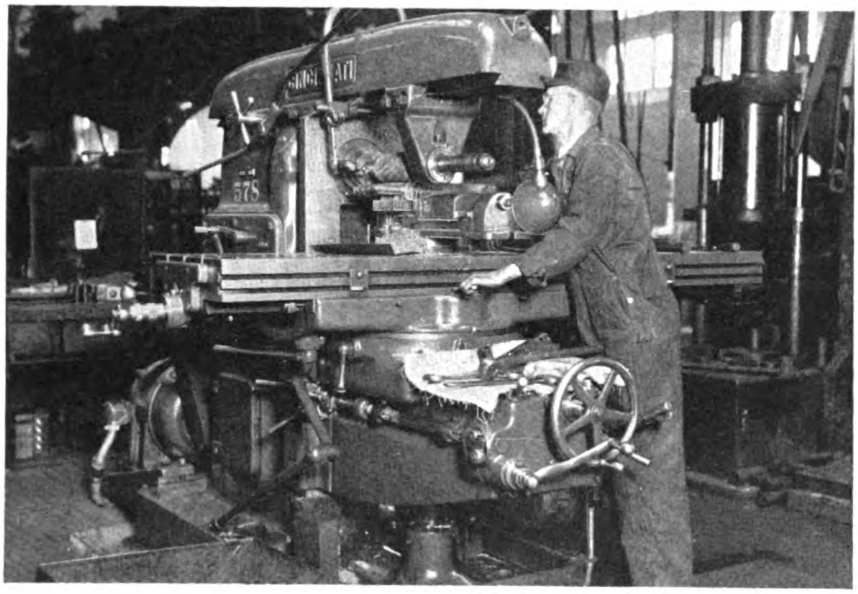




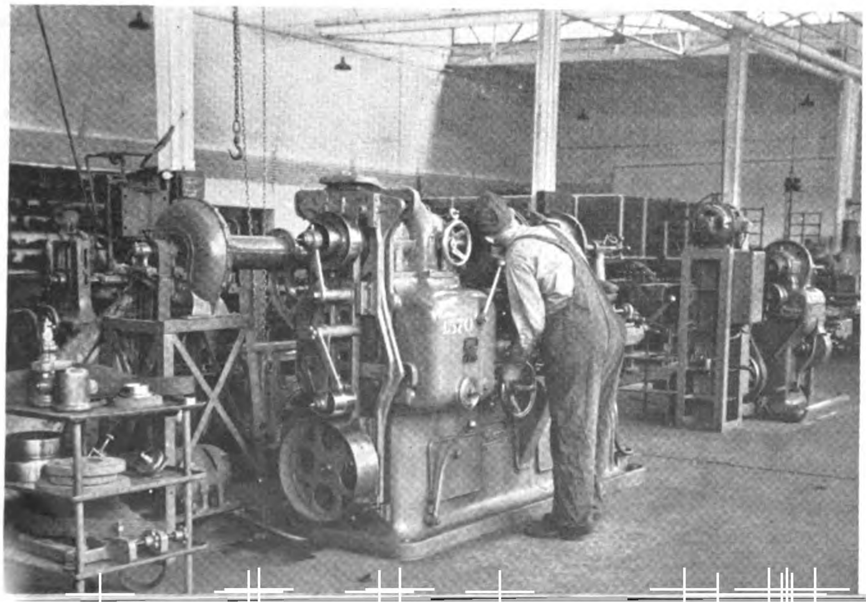
The three jobs shown on this page are additional evidence of the standard of precision which assures the satisfactory operation of the modern locomotive—At the top is an internal grinder finishing a bushing; at the center, a piston rod is being ground and, at the bottom, a retainer ring for a driving-wheel roller bearing is seen being finished on a surface grinder



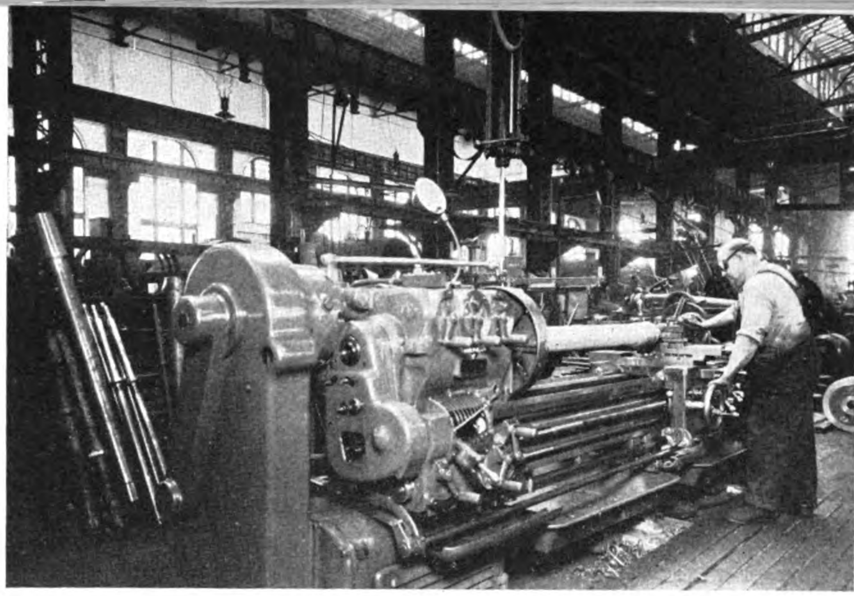
The radial drill plays a most important part on a variety of shop operations involving drilling, reaming and tapping—Power, plus flexibility of speed and control simplify many difficult jobs—The machine shown here is saving from 35 to 40 per cent compared with the one replaced



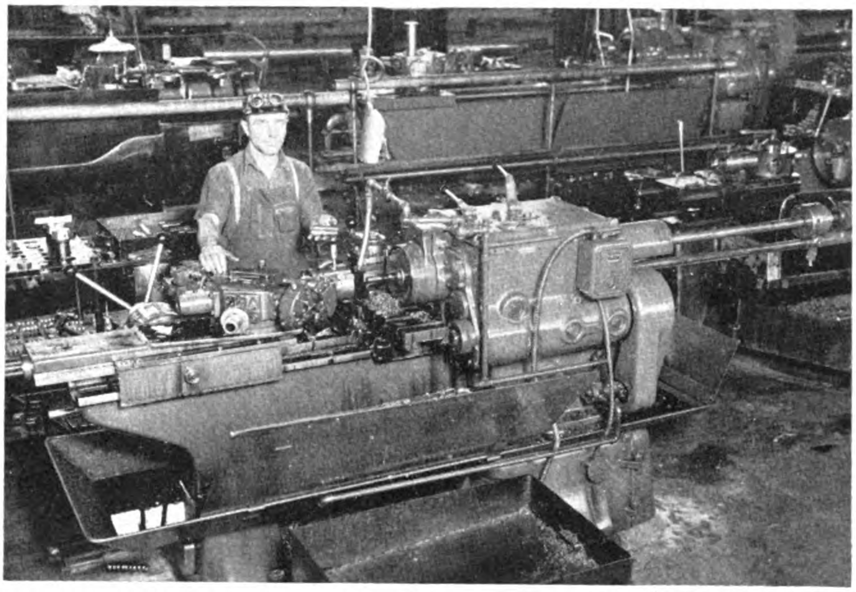
The knee-type milling machine handles many of the unusual machine-shop jobs such as motion work and small rod parts —This one is at work finishing a spring seat for a trailer truck



The internal grinder for the finishing of locomotive air-compressor cylinders, power reverse-gear cylinders and stoker-engine cylinders has contributed much to the reduction of repair costs

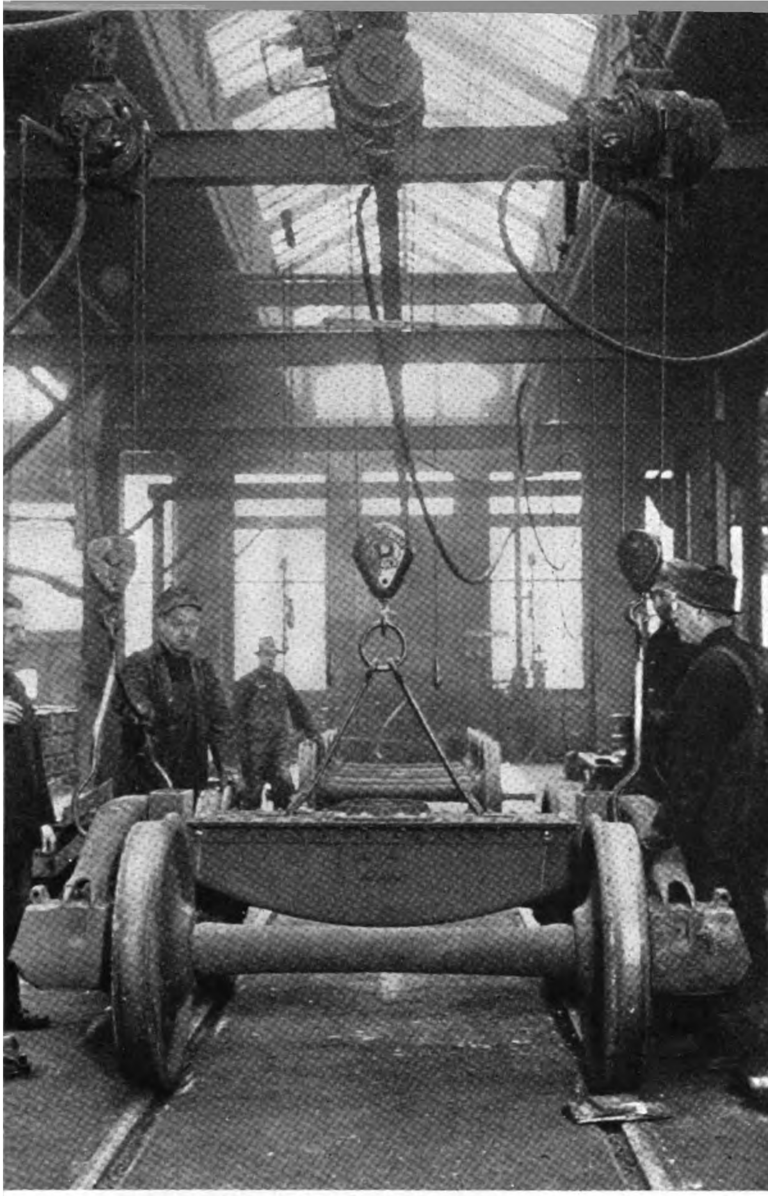


Because of the variety of heavy machining jobs on which production is not in great volume the engine lathe holds its place in the backbone of the railroad machine shop—Modern machine design plus new tool steels has speeded up the work and it is possible today to turn out many locomotive parts to a standard of accuracy that, a few years ago, was considered impossible



Quantity production of hundreds of parts used by a railroad have brought out the advantages of properly tooled turret lathes—Many of the larger shops are concentrating turret-lathe work in a separate department where constant supervision and trained operators are developing surprising reductions in the costs of machining miscellaneous parts

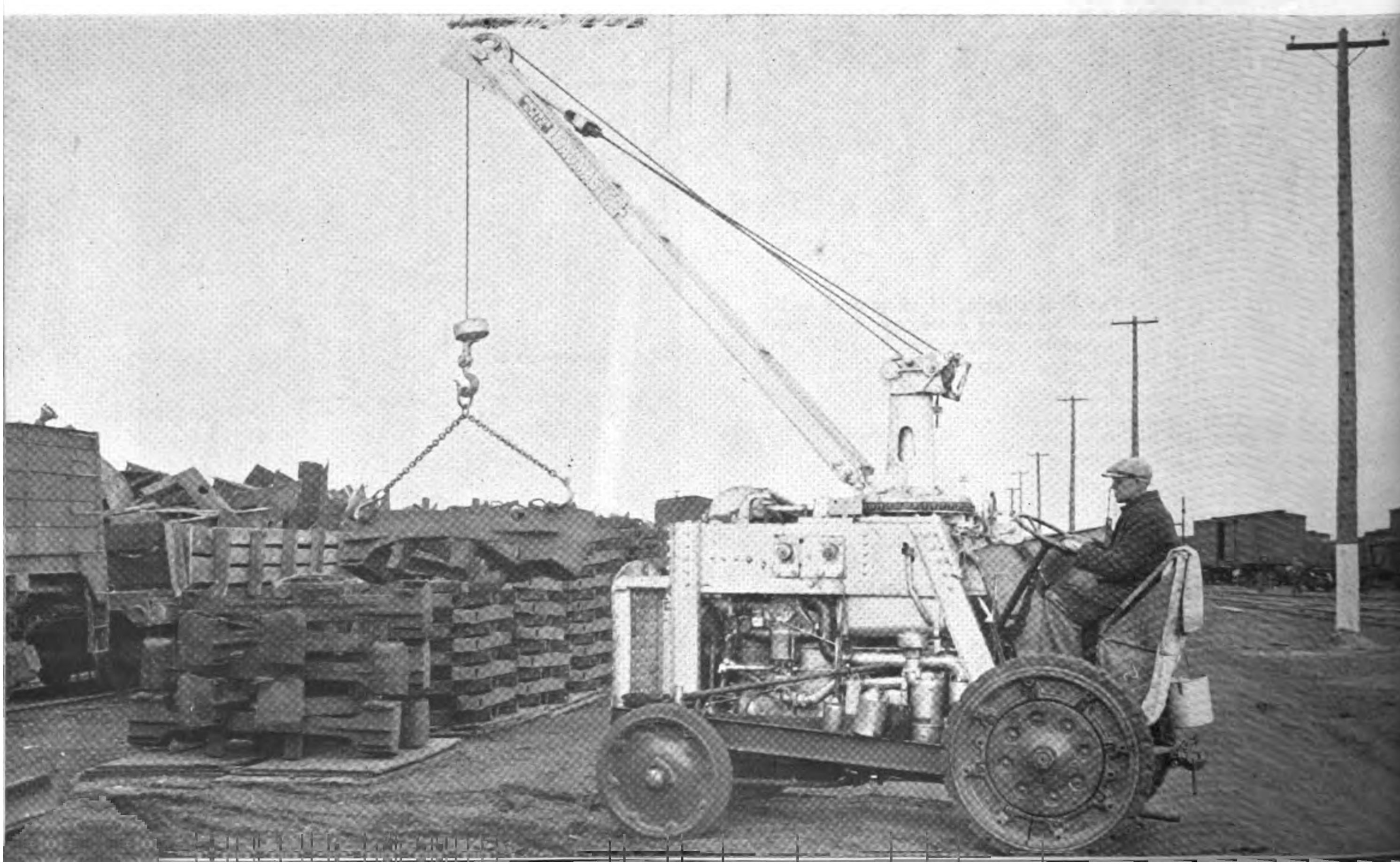
The hand chipping of oil grooves in the crown brasses of driving and truck boxes is gradually giving way to the special machine which cuts accurate grooves quickly



The elimination of arch bar trucks means the rebuilding of thousands of car trucks —The simple overhead pneumatic hoist installation shown here cuts truck assembly time down to 12 to 15 minutes

Welding on steel cars cuts costs, reduces weight and produces a car that stands up well under today's severe service demands

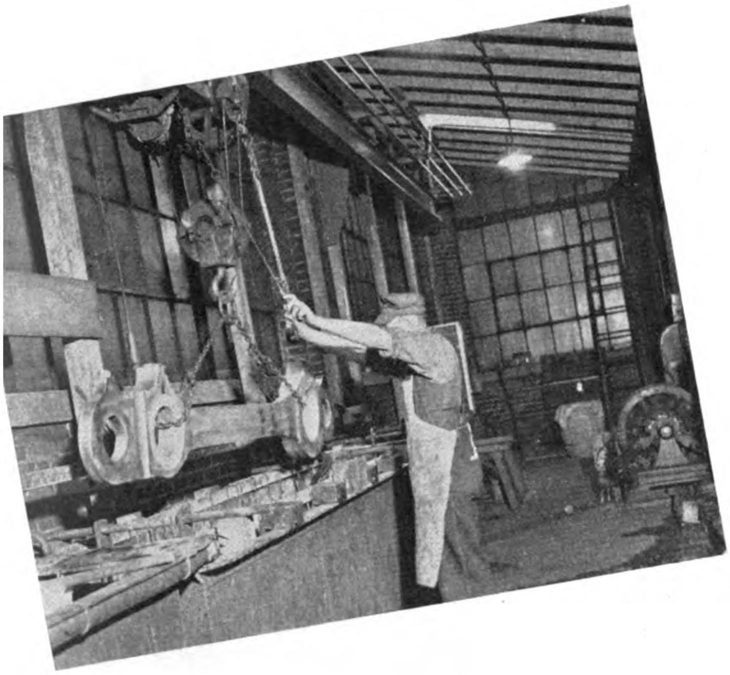
Car repair yards, spread out as they usually are over acres of ground, present many difficult problems in the handling of material—Gasoline and electric crane trucks have combined flexibility of operation with a relatively low investment cost resulting in the ability to alter car yard layouts to suit the character of the repair job at hand



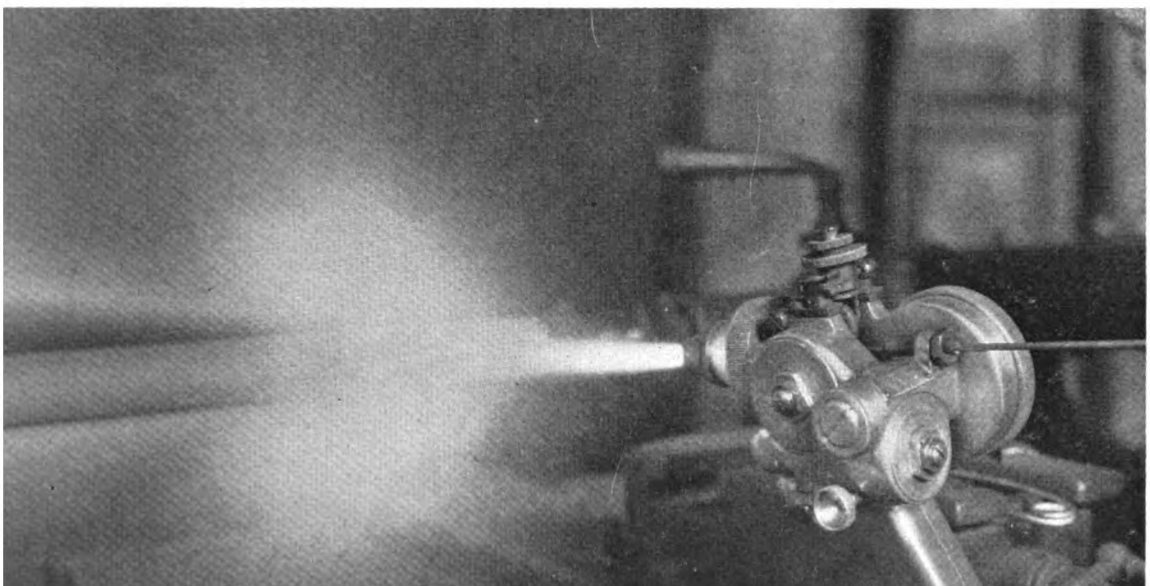
The modern railroad forge shop embraces many units of equipment that have been brought into the picture as a result of the development of new steels, heat treating, forging work and shape-cutting parts

An electric flash welder at work on large boiler tubes

The ingenuity of die designers, together with the forging machine, has made it possible to produce forgings of complicated design in large quantities at lower cost



This page is just a suggestion of some of the new things that are to be seen in the railroad shop—Above: a workman lifting a side rod from the plating tank where it has been coated with zinc to resist corrosion and improve its appearance—Right: the electric tin snip, typical of many ingenious small high-speed tools—This one cuts all sorts of shapes and increases the productivity of the workman many times over the old hand shears



A close-up of a metal spray gun working on an air-pump piston —In one railroad shop which within the past two years has made a large investment in shop equipment, the metal spray department shows the largest savings in percentage on the investment of any shop equipment bought at that time

EDITORIALS

Atlantic City Convention

We are presenting in this number a "high spot" review of the progress and innovations made in the mechanical department during the past seven years, or since the last big convention and exhibit was held at Atlantic City. We hope that many of our readers will have the opportunity of visiting Atlantic City during the meeting this year, June 16-23, inclusive, in order to get a "close-up" and more complete picture of the truly remarkable progress which has been made in the design and construction of mechanical department equipment and facilities.

All exhibit space in the great Auditorium will be utilized, and in addition there will be an elaborate track exhibit. Many mechanical-department executives, recognizing the educational value of the exhibit, are arranging to have as many of their supervisors and foremen as possible visit Atlantic City during the conventions, and methodically and studiously examine those exhibits of special interest and significance to them.

The occasion will be almost equivalent to a post-graduate training course, since the outstanding improvements in recent years will for the first time be shown in one place and in an effective manner. The exhibitors are quite deliberately and carefully planning to arrange the presentation of their products to take advantage of this exceptional educational opportunity.

Some innovations will be made this year. The exhibit will be thrown open to the general public on the Saturday and Sunday intervening between the Mechanical Division meetings. Then, too, in addition to the meetings of the Purchases and Stores Division during the second week, and at the meeting of the Association of Railway Electrical Engineers on June 17, the Air Brake Association will meet on June 17 and 18. Locomotive reports will be considered during the first three days of the Mechanical division meeting, and car reports during the last three.

The Atlantic City conventions and exhibit this year have a peculiar significance. They mark a long stride in the return to more normal and prosperous conditions—they are an evidence of a return of confidence and the conquest of fear.

Some measure of the progress which is being made is indicated by the fact that the freight-car loadings for the first twenty weeks of this year were 14,377,453, as compared to 12,466,650 in 1936, an increase of more than 15 per cent.

Vice-President J. M. Symes of the Association of American Railroads, told the members of the Operating-Transportation Division, at its annual meeting in Chicago May 19 and 20, that the Car Service Division predicted freight-car loadings of over 900,000 cars per week this fall for nine consecutive weeks, with a peak week of 960,000 cars, as compared to a peak of 827,000 cars in 1936. "It looks at this time," Mr. Symes said, "as though there will be about 95,000 more serviceable cars available than a year ago. This is approximately a nine per cent gain. Can a nine per cent increase in cars provide for the loading of an expected 15 per cent increase in traffic? It can be done by efficiency in car handling, but only by the utmost coöperation between railroads, and with the Car Service Division."

General business is being stimulated in no small degree by the equipment now being built for the railways. This year, for the months of January, February, March, April and the first three weeks of May, the railways ordered for domestic use 206 locomotives, 44,562 freight cars and 446 passenger cars. The comparable figures for 1936 were 98 locomotives, 22,240 freight cars and 87 passenger cars. During the same period last year no equipment was ordered for use in Canada, while this year there were ordered 50 locomotives, 7,358 freight cars and 80 passenger cars.

Those in charge of the calling of the conventions and the holding of the big exhibit had to make their decisions a long time in advance—but they surely guessed right!

Adequate Car-Repair Facilities Needed

The need for improved freight-car repair methods and facilities on many railroads cannot be better summarized than in the following brief quotation from an address presented at the April meeting of the Car Foremen's Association of Chicago, by K. F. Nystrom, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific:

"To carry out a successful and economical schedule repair program, it is obvious that proper repair facilities must be made available. In this respect the car department again has not, on most railroads, been given the consideration it deserves. There are today large railroads who do not have a resemblance of modern freight-car repair shops; some are still making

freight-car repairs out in the open. A modern repair shop will increase the efficiency in labor at least 20 per cent and also establish a considerable saving in the conservation of material and small tools.

"I believe that at the present time if a survey was made of locomotive shops, which some railroads have abandoned, it would be found that these could, at comparatively small cost, be converted into suitable freight-car repair shops.

"The location of repair shops is of great importance. They should be located where the density of traffic is the greatest and where there is a prevailing empty-car movement. Some years ago, the idea prevailed that repair shops should be scattered over the railroad, but that is not necessary. It is better to have one suitable shop with proper tools than several shops without facilities."

The Milwaukee evidently believes in the old adage that "a doctor should be willing to take his own medicine" for in 1931 it constructed a modern freight-car repair and car-building shop at Milwaukee, Wis., which has been instrumental in cutting the cost of schedule repairs from $199 a car in 1929, to $132 a car in 1936. In addition, a substantial amount of new equipment has been constructed in this shop, which is one of the best equipped in the country, particularly as to modern welding machinery, and is said to have more than paid for itself in the period of six years since it was built.

One thing about freight-car repair work which can hardly be questioned is that in northern climates subject to severe winter conditions, any heavy repair work which is performed out of doors is done with some more or less serious loss in efficiency. Higher railroad managements must be impressed with this fact, but perhaps not by such a drastic method as that followed on one railroad where the president was induced to inspect certain car-repair track work on a cold winter day and froze one of his ears during the inspection trip. A modern repair shop was subsequently built at this point, doubtless for economic as well as personal reasons!

Climb Out Of the Rut

Is it advisable for mechanical-department supervisors and foremen occasionally to visit points on their own line or on other railroads, in order to compare practices, with a view to improving their own operations? An industrial engineer told a small group recently of some well worthwhile improvements he had suggested in the operating methods of an equipment repair plant. Asked why he could go in from the outside and suggest such improvements he shrugged his shoulders and said the people in charge of the plant had allowed themselves to get into a rut.

Getting into a rut is an expensive business and it cannot be overcome by ordinary methods. Even men of constructive genius and plenty of initiative profit greatly by meeting and comparing notes with those who are engaged in like pursuits in other places. It does take time and it does involve expense to make such visits, but the average man will be sufficiently inspired and helped by such experiences to warrant the expenditure of time and money. We know of one successful railroad shop superintendent who frequently takes a few hours off to visit manufacturing plants in his own community. True, their problems and methods are radically different from those in a railway equipment repair plant, and yet this shop superintendent almost invariably comes back to his own job with some good idea which can be applied to its peculiar operations.

How does the other fellow do the job? Don't try to find what you are doing better than he is, but profit by trying to discover those ways in which he excels. The industrial engineers are not supermen. True, they are specially trained to discover weak spots and suggest better practices—the important thing, however, is that they keep their eyes and minds wide open at all times. Why not rip off the blinders and climb out of the rut; a trip to other shops or facilities on your own or some other road will make an excellent starter.

Drill Tang Breakage

An instructive engineering bulletin, recently issued by a nationally known tool manufacturer, calls attention to a well-known fact regarding the causes for drill-tang breakage which may well be re-emphasized. Drills and other cutting tools with taper shanks are driven by a combination of frictional contact with the drill socket and by the inter-lock of the tang at the end of the taper with the tang slot in the socket. Any attempt to drive the drill by either of these features alone, without the aid of the other, is likely to cause trouble which in some instances has been blamed on the drill maker.

To prevent possible difficulties from this cause, two precautions must be observed, namely, to make sure that the drill socket is not excessively worn and that it is clean and free from dirt, chips or other foreign material. The suggestion may be made that, since the tang cross-section is smaller than any other part of the average drill, it might be enlarged to prevent failure, but this would make the drills unusable in present drilling equipment and this suggestion is therefore not practicable. Obviously, the solution is to keep the drill sockets clean and recondition them as often as inspection shows that the socket has become worn out of round, bell-mouthed, or roughened on the inside.

Gleanings *from the* Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

Place More Emphasis on Safety

The increase in business that has taken place in the last year or so has necessitated the rearrangement of a large percentage of the working force, a great many furloughed men have returned to duty and a sizeable percentage of new men have been taken into the service. These factors all tend to make accidents more likely to occur.

The Human Side

I like the *Railway Mechanical Engineer,* because, in spite of its highly technical articles it also contains a goodly supply of practical material that is extremely helpful to us in solving some of our more simple, everyday problems. Then, too, I like your human interest articles and comments. After all, man power is the most vital factor in our operations, in spite of the marvelous improvements that have been made in materials, equipment, machinery and facilities. The degree of efficiency and economy which result from these things, however, depends upon the human element, which must construct, maintain, operate and control them. Frankly, I sometimes wonder whether we recognize the importance—yes, vital necessity—of properly training and cultivating the human element in our organizations, in order to secure the best and most satisfactory co-operation from it. Do our supervisors and foremen, for instance, feel that they have the complete confidence of the management in dealing with the troublesome problems which confront them at every turn? Have they been coached or instructed as to how to deal with the workers, in order to inspire the highest type of teamwork? Where would a football team or baseball team get without thorough training in co-operative effort and endeavor? Are the executives doing all they should to train the supervisory staff in the art of management Are the foremen rightly approaching the problem of getting the best and most loyal service from the men under them? Are the men in the ranks and new recruits being properly trained, so that the railroads may take full advantage of more modern methods and practices, and thus more successfully withstand the various types of competition with which they are now confronted?

Large Heating Surfaces

In going through some of the older issues of the *Railway Mechanical Engineer* I noticed a comment about the remarkable heating surface of the 4-8-4 locomotives purchased by the C. & O. last year. The combined heating surface of this locomotive is 7,880 sq. ft., with an evaporating surface of 5,538 sq. ft. The C. M. St. P. & P. has a 4-8-4 locomotive which has a combined heating surface of 7,803 sq. ft., which is deserving of mention, I believe, as the second largest heating surface.

Are We Railroaders Becoming Soft?

"Hello, Boss!"

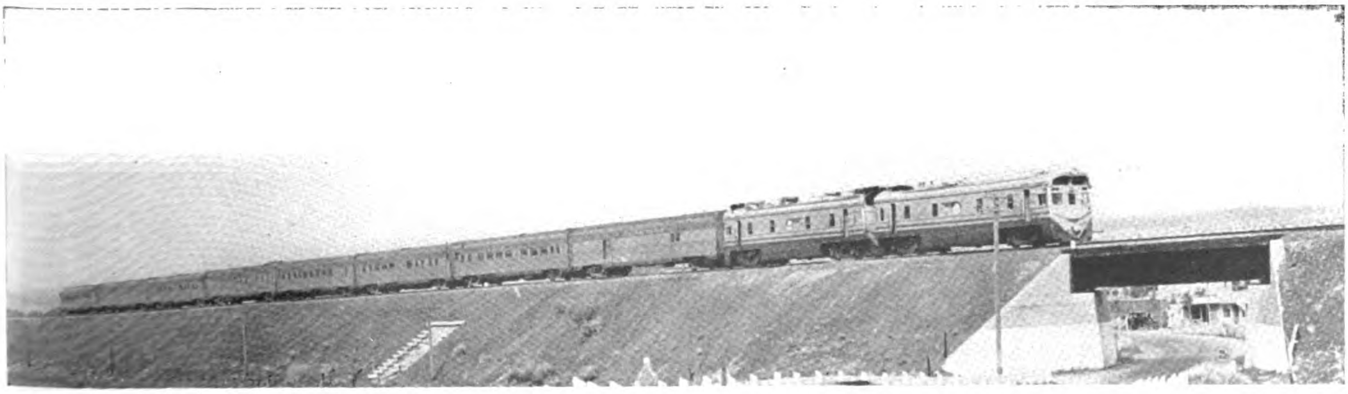
Looking up from where I was working in the garden among my spring flowers I found Old Dave, who was pensioned by our railroad at sixty-five, ten years ago. "Why, hello, Dave, how are you?" I said. "I haven't seen you for a long time, although I often think of you."

"Yes, I'm sure you do, Boss. I just dropped around this evening to let you know I got the nice letter which you sent me on my seventy-fifth birthday, although I don't know how you remembered it. To realize that you did and that you went to all the trouble of writing a letter with your pen just made my birthday the happiest ever. It was the best present I got, and I want to thank you for doing it."

"Why, that's all right, Dave, God bless you. You've made me happy, too, in coming around to tell me about it."

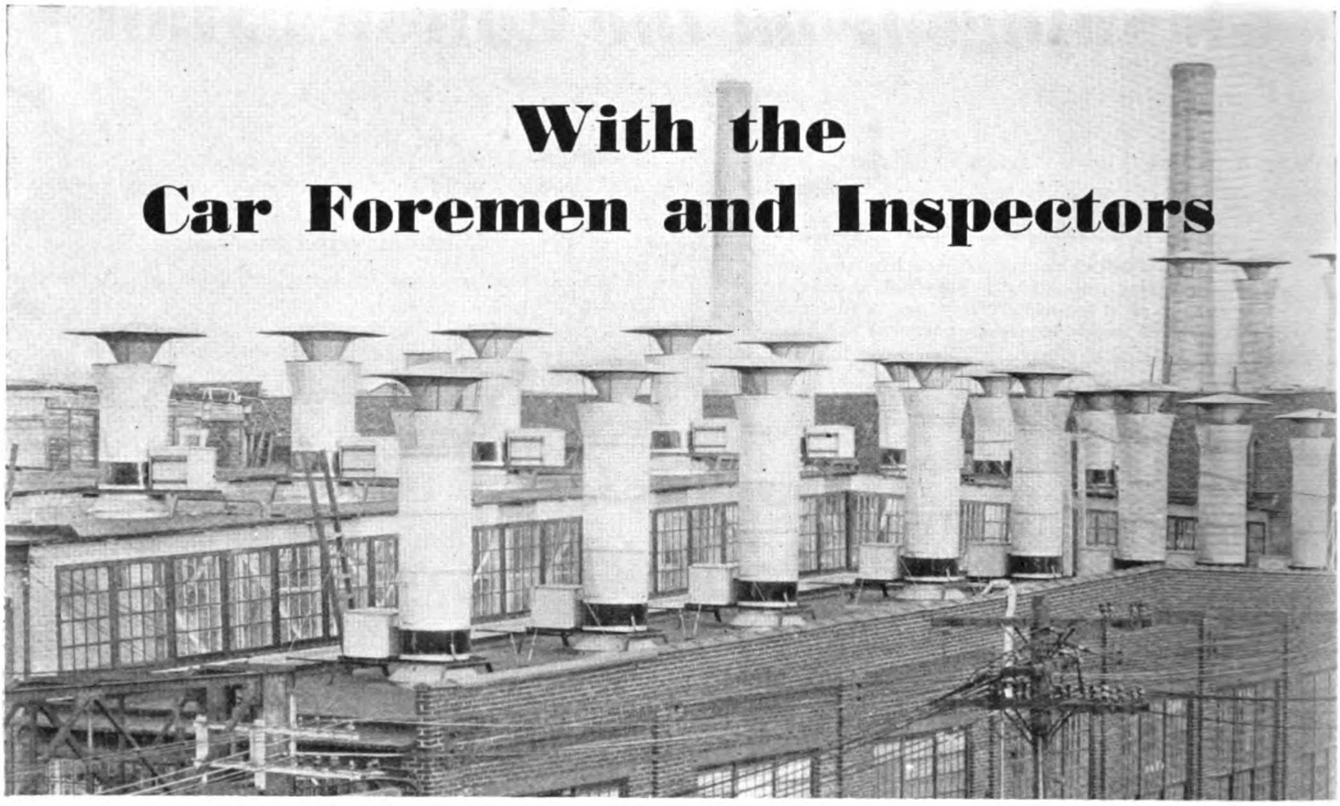
Blue Signal Rules Disregarded

On the reverse side of our time cards we are cautioned to practice safety and put tools and apparatus in a safe and serviceable condition, regardless of whether we have the approval of the foreman to use the necessary time and material. In addition to these very explicit instructions on the time cards, we are frequently reminded by bulletins and posters which originate with the Association of American Railroads that *safety must be given first consideration.* Production, however, has become such a religion that the men will not dare take the required time to do as the rules and posters and bulletins dictate. By the most vicious coercion of inspectors by dispatchers, yardmasters and train crews, the blue signal rules are worse than jokes. Because of competition, very little dead time is allowed for a train to be in the yard. Consequently, pressure is applied and trains are inspected and switched at one and the same time. Safety is a subject that, in my opinion, should be given space in your magazine more frequently.



Light-weight Super Chief on the Santa Fe, with original Diesel locomotive—The new locomotive is now in service

With the Car Foremen and Inspectors

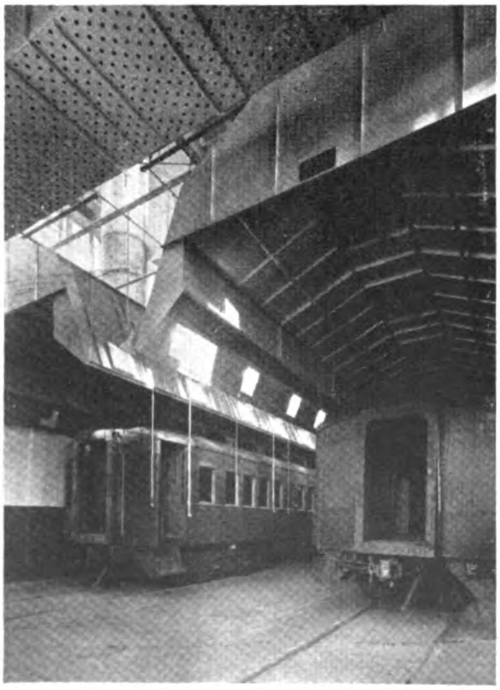


The canopy discharge stacks on the roof of the West Albany paint shop

Features of N.Y.C. West Albany Paint Shop

A passenger-car paint shop complete with canopy-type exhausting units, explosion-proof equipment, and facilities for replacing exhausted air with heated and filtered air was placed in operation at the West Albany shops of the New York Central system on December 9, 1936. The arrangement of this shop together with its air-replacement facilities make it one of the best equipped of its kind in the country, and makes possible a scheduled production of four cars every eight-hour working day, with a maximum of four cars in the paint shop at any one time. The number of passenger cars required in the shops at one time has been reduced approximately one-third by the installation of the spray shop. The quality of the work done is improved by the provision of an adequate supply of filtered replacement air heated when and as required.

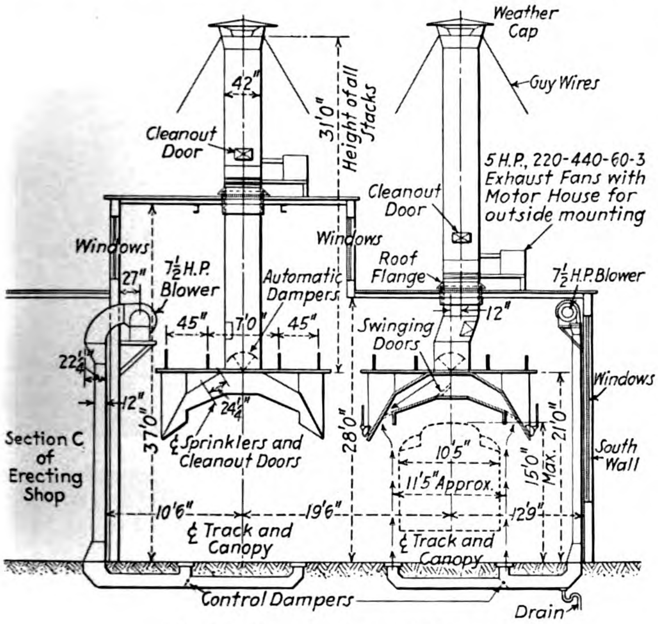
The spray room, which was formerly a battery and electric shop, is located at the south wall end of the main passenger-car erecting shop which is 420 ft. long, 200 ft. wide and 28 ft. high under the roof girders. This building is divided into four sections—*A, B, C* and the spray room—the latter of which is separated from section *C*



Left: Two parallel exhaust canopies each 180 ft. long accommodate four cars—The canopies are divided into 18-ft. sections with separating bulkheads and one exhaust stack for each section

Right: A passenger car beneath one end of a canopy ready for spraying—Note the ample artificial and natural lighting facilities

by a fire wall. Sections *A* and *B* of the erecting shop have a total capacity of 26 cars on 13 tracks while section *C* has a capacity of 12 cars on six tracks which as a rule are reserved for puttying, knifing, and sandpapering cars before they go to the spray room for finish painting. The erecting shop and spray room are provided with transfer-table facilities on the east and west sides which make for greater flexibility in shop operation and expedites car movements in and out of the shop. All car



Section through the paint shop

movements in and out of the spray room are made during the noon hour or during the night.

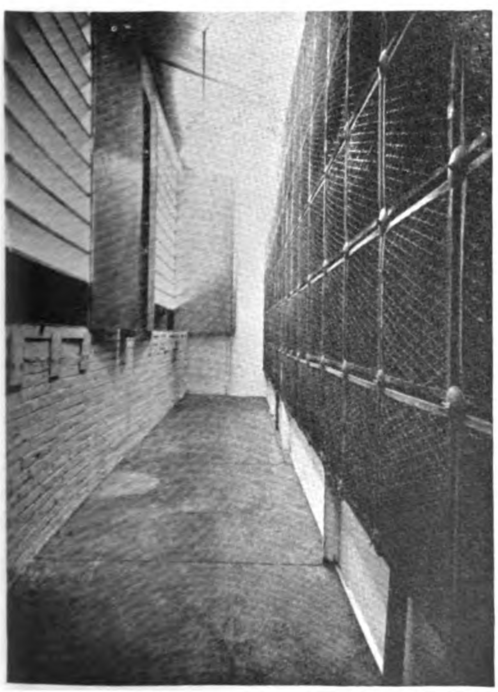
The spray room is 200 ft. long and 42 ft. 9 in. wide inside. There are two tracks in the room which accommodate two cars each under exhaust canopies 180 ft. long made up of 18-ft. sections with separating bulkheads and one exhaust stack for each section. The roof of the spray room above the track adjacent to the south wall of the room is 28 ft. high, while a bay above the track adjacent to the fire wall extends the roof to a height of 37 ft. as shown in the sectional drawing of this room. Both sides of this bay, which is 9 ft. higher than the roof above the track nearest the south wall, have windows for its entire length of 200 ft. The south wall of the room, as will be observed from one of the illustrations, is approximately 60 per cent window space.

Car trimming, and the paint spraying of small car parts, is done in a building apart from the erecting shop. Separate buildings are also used for washing cars and for repairing and fabricating removable car parts, including trucks, electric generators, batteries, air-conditioning equipment, and air-brake equipment. The main car-shop offices, as well as blowers, filters, and heater units for heating, filtering, and replacing exhausted air for the spray room, are located on the second floor of the main erecting shop.

Air Replacement Facilities

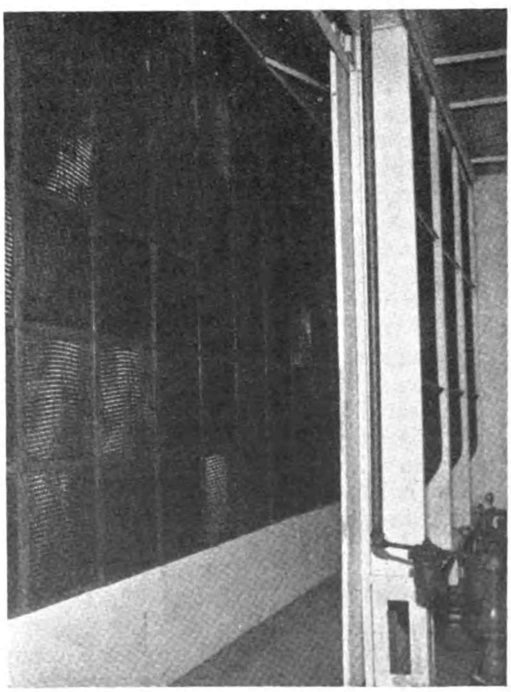
The equipment for the spray room includes units for heating, filtering, and delivering the air introduced into the spray room, and also induced-draft fans in the exhaust stacks of the spray canopies for exhausting the air from the spray room. Based on an average of 12 of these exhaust fans in operation at one time, 307,000 cu. ft. of air per min. will be exhausted from the room. Of this volume 107,000 cu. ft. per min., or 35 per cent of the total comes into the spray room by infiltration through openings around doors and windows. The remaining 200,000 cu. ft. per min., or 65 per cent of the total, is replaced by mechanical means at a controlled temperature to maintain the average temperature of the spray room at 70 deg. F. during cold weather.

Of the 200,000 cu. ft. per min. replaced by mechanical means, 100,000 cu. ft. per min. is furnished by two blowers each with a capacity of 50,000 cu. ft. per min., located in a heating room on the second floor above section *C* of the erecting shop; 75,000 cu. ft. per min. is delivered by a blower which was formerly a part of the erecting-shop heating system, and 25,000 cu. ft. per min. passes from section *C* of the erecting shop through ten $1\frac{3}{4}$-ft. by $6\frac{3}{4}$-ft. filter-equipped openings in the spray-room fire wall. Two unit heaters, each with a capacity of 12,500 cu. ft. per min. are located near the roof of section *C* of the erecting shop, as shown in one of the illustrations, to compensate for the heat



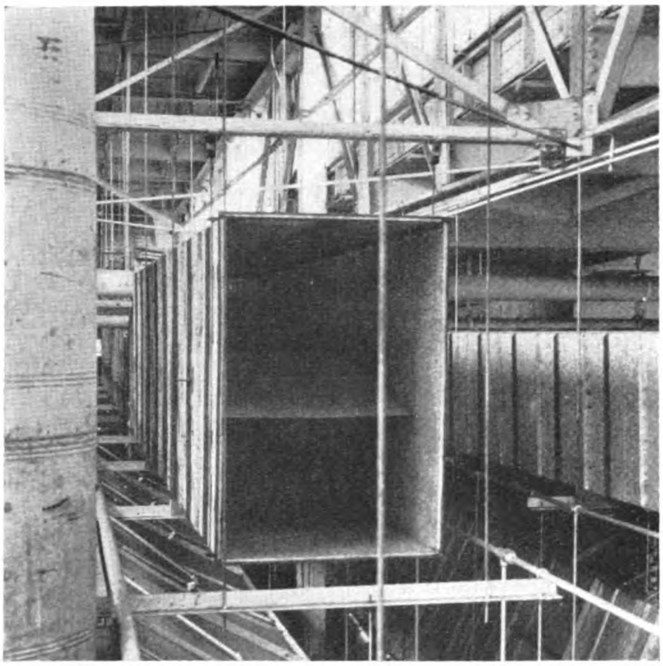
Left: Air for the spray room is drawn in through a set of louvers and passes to a bank of spun-glass filters

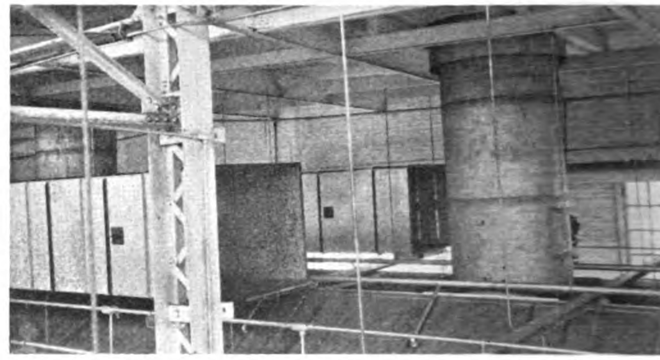
Right: The outlet side of the filter bank—The air passes over the heating coils shown at the extreme right or by-passes the coils through the door shown in the foreground



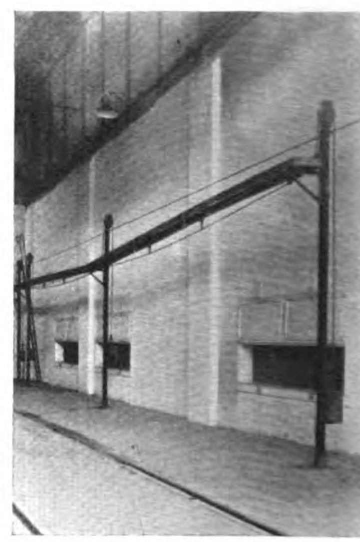
loss occasioned by the 25,000 cu. ft. per min. of air which passes from this section to the spray room through the ten filter openings in the fire wall.

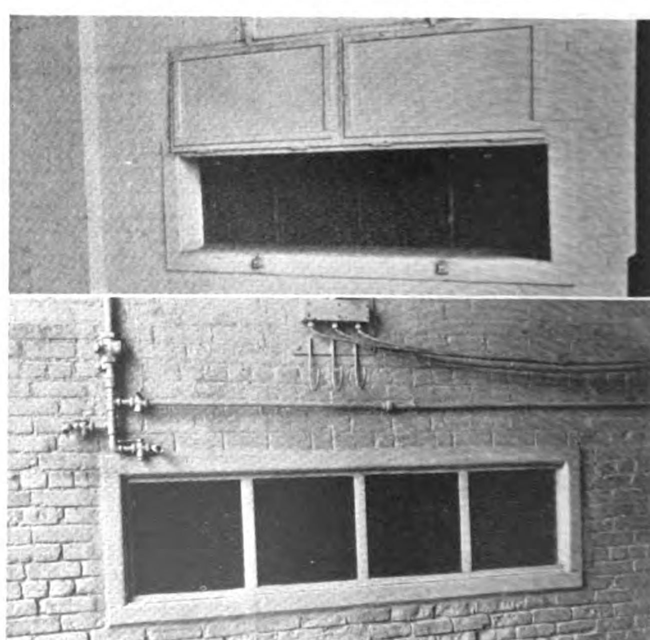
The 75,000 cu. ft. of air per min. furnished by the blower which was formerly a part of the erecting-shop heating system is filtered before being delivered to the spray room, and when required it can be heated to a maximum temperature of 126 deg. F., which temperature may be required to maintain a spray-room temperature of 70 deg. F. with infiltration of extremely cold outside air through doors and windows. The air from





Left: Outlet duct from one of the 50,000-cu.-ft.-per-min. blowers—Top: The two outlet ducts from the other 50,000-cu.-ft.-per-min. blower



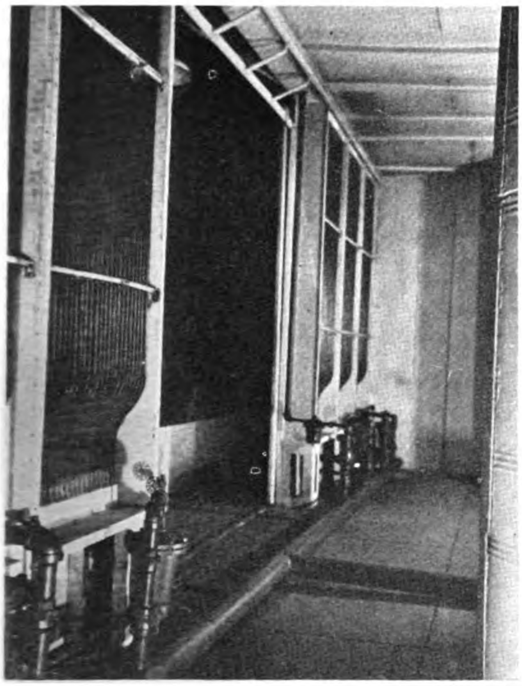


Right: The erecting-shop side of the fire wall showing filters for the air entering the spray room from section C of the erecting shop—Bottom: The inlet and outlet sides of the filter banks in fire wall between Section C and the paint shop

this blower is delivered by two ducts, one at each end of the spray room. Each of these ducts runs the width of the spray room and is located beyond the ends of the canopies and above their lower side; both ducts are drilled with 1¼-in. holes in the side nearest the canopy and in the bottom for diffusing the air at low velocities into the spray room.

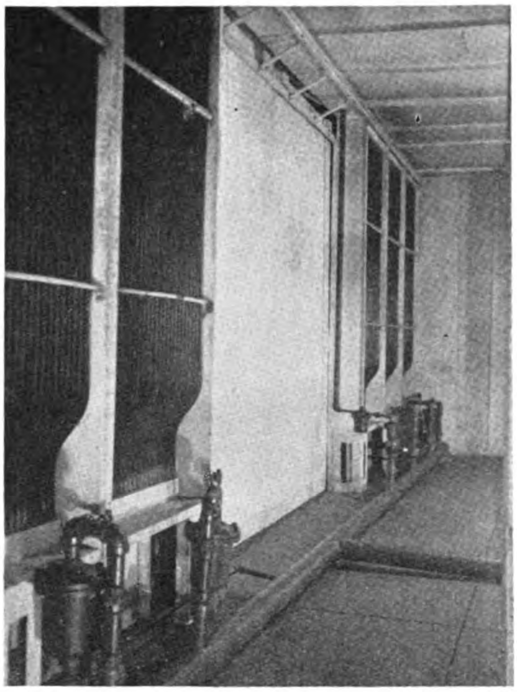
The 100,000 cu. ft. of air per min. supplied by the two blowers in the heating room above section *C* of the erecting shop, is drawn in through louvres in the east side of the shop; the louvers can be blanked off by hinged doors to control the volume of incoming air as required. This air then passes through a filter bank 21 units wide and six units high containing 126 throw-away type spun-glass 20-in. by 20-in. by 2-in. filters. From the filters the air passes through two fin-type coil heater banks which have a sliding partition between them for regulating the volume of air which passes over the heater coils; the volume can be controlled so that the maximum temperature of the air delivered to the spray room will be 126 deg. F.

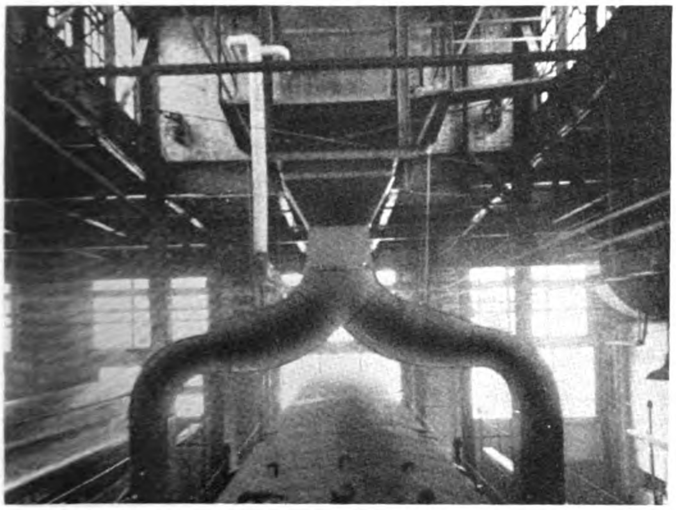
The heated air from one of the 50,000-cu-ft.-per-min. blowers is delivered to the spray room through a side outlet into a 75-ft. duct which runs into the spray room over the exhaust canopy nearest the fire wall. This duct is made in three 25-ft. sections 3 ft. 6 in. wide, with heights of 7 ft. 3 in., 6 ft. 4 in., and 5 ft. 4 in., respectively. This duct has two rows of 1 in. by 15 in. slots spaced on 4 in. centers cut in the top and in the side facing the fire wall. The air from the other 50,000-cu.-ft.-per-min. blower passes through a Y-connection bottom outlet and is delivered into the spray room by two 100-ft. ducts over the top of the canopy nearest the south wall of the room. These two ducts are 3½ ft. square for their entire length of 100 ft. The duct nearest the south wall of the spray room has 1-in. by 15-in. slots in the top side spaced 11 in. apart. The other square duct has 1-in. by 15-in. slots in the top side spaced 5½ in. apart. All of these three ducts over the canopies have back-draft dampers located 3 ft. from their ends. The slots in the three ducts over the canopies diffuse the air at very low velocities over the portions of the canopies equal to the length of the ducts, with the remainder of the air being



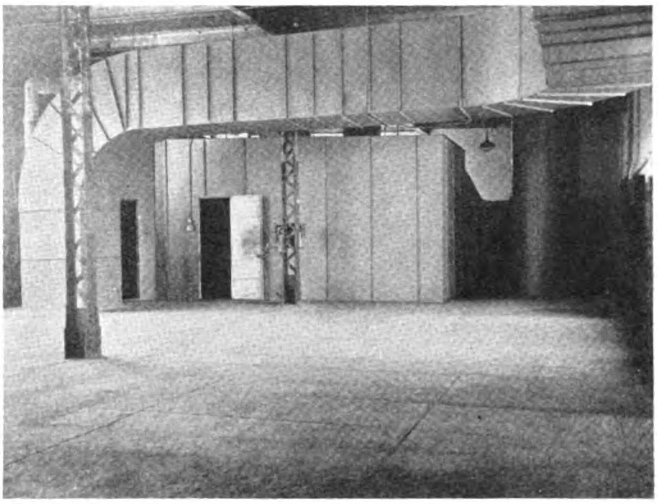
Left: The two heater coils with the separating door wide open for passing a minimum amount of air over the two coils—The filter bank can be seen through the door

Right: The heater coils with the separating door closed for passing a maximum amount of air over the two coils—During extremely cold weather the air can be heated to 126 deg. F. with the doors in the position shown in this view





One of the two unit heaters in section C of the erecting shop, each of which replaces 12,500 cu. ft. of air per min. that passes through the fire wall between section C and the spray room



The fan room above section C of the shop—The duct in front of the room delivers 75,000 cu. ft. of air per min. to the paint shop from the erecting-shop heating system

blown from the ducts at a velocity which does not exceed 3,000 ft. per min.

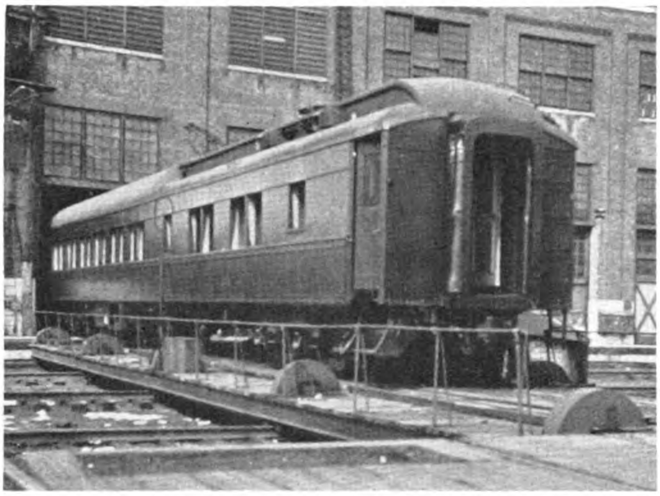
The design of all five ducts in the spray room is such that the air is delivered into the spray room at velocities which eliminate all drafts. This provides comfortable working conditions in the spray room and improves exhaust conditions. With an average of 12 exhaust fans removing an air volume of 307,000 cu. ft. per min. from the spray room, 23,400 B.t.u. per hour are required of the heating system to maintain a spray-room temperature of 70 deg. F. with an outside temperature of 0 deg. F. However, 23,900,000 B.t.u. per hr. are available from the combined heating units which will take care of heating extra air drawn into the spray room by infiltration through openings around doors and windows; this total will make up the entire heat loss in the 307,000 cu. ft. of air per min. exhausted through stacks.

The steam supplied for the fin-type heaters previously mentioned is taken from the main shop supply line and is reduced from 120 lb. per sq. in. to a maximum of 60 lb. per sq. in. A thermostat in the steam line to the unit heaters will shut off the 50,000-cu.-ft.-per-min. blowers in the event the steam temperature falls below 240 deg. F. This precaution is taken to prevent the coils from freezing should the steam pressure and temperature fall to such a point where sub-freezing air drawn over the heaters might freeze the coils.

Canopy Exhaust Equipment

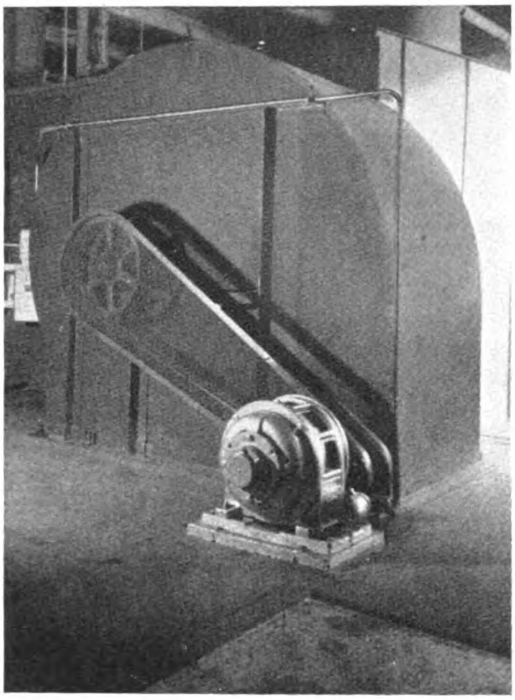
The two exhaust canopies in the spray room are 180 ft. long and are made up of 18-ft. sections with separating bulkheads and one exhaust stack for each section. Thus the amount of air exhaust from the room can be controlled as required, the number of sections in operation being determined by the location and number of spray operators working. The exhaust stacks have clean-out doors and dampers, the latter of which are kept closed when the section is not being operated, thus economizing in heating costs by preventing the escape of air from the room at such points where exhausting facilities are not needed.

The exhaust stacks have weather caps designed to pro-

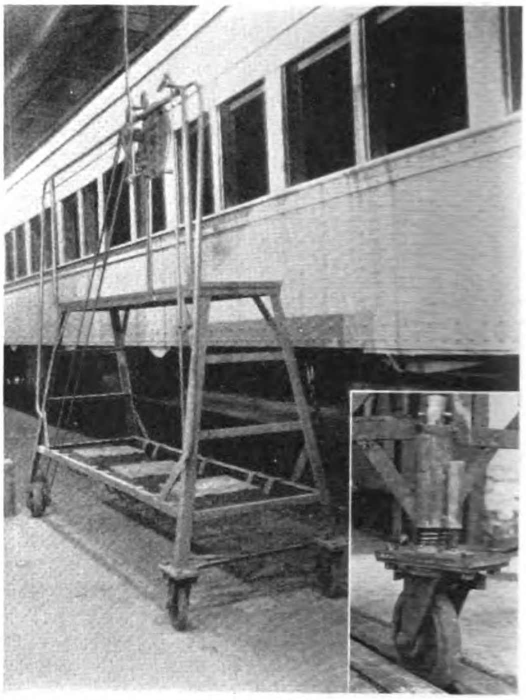


erator, thus protecting him from all fumes and odor. These fumes and odors are carried into the canopy and exhausted by the fans in the stacks. Distributing plates in the floor ducts are used to maintain a uniform air-delivery pressure through the slots at velocities which can be varied between 200 and 500 ft. per min. The sectional drawing of the spray room shows blower locations and delivery ducts. All four blowers are located in spray room and delivery ducts from those on the south wall lead directly to floor ducts while those on the fire-wall pass through the wall into section *C* and return through the wall at its base into floor ducts. All of these ducts are shown in the sectional drawing of the paint shop.

The canopies in the spray rooms are fitted with deflectors so that the flow of air from the floor slots can be diverted to permit air flow directly upward past the side of the car, through the car for interior painting, or across the top of the car for roof painting; in the latter



Top: Finished car leaving the paint shop—The inlet air louvers can be seen above the car—Left: One of the 50,000-cu.-ft.-per-min. blowers

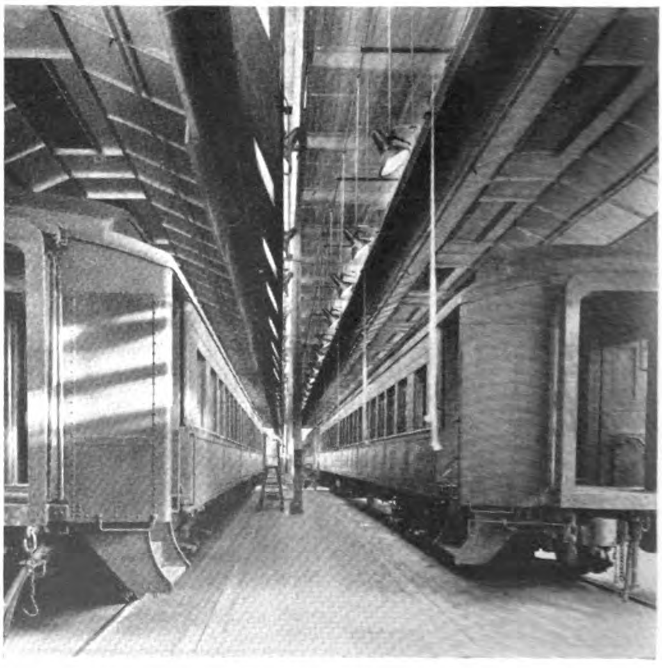


Right: Dolly used in the paint shop when spraying upper sections of car sides —The insert shows the compensating device on one of the dolly wheels to prevent tipping when running over floor irregularities— Bottom: Artificial lighting facilities include thirty 300-watt lights at each edge of each one of the canopies

tect the interior from all weather conditions and to allow the air to pass out to the atmosphere with a minimum of resistance. Sufficient clearance between the roof and the exhaust piping is obtained by the use of roof collars. Sheet-metal aprons, installed directly above and as a part of the roof-collar assembly, are furnished for the deflection of rain, sleet and snow.

The fans for exhausting the canopies are driven by motors located outside the stack and connected to the fan by means of V belts. The V belts are covered with a cast-iron vapor-proof housing and cover plate sealed with a rubber tube gasket, thus avoiding fire hazard and conforming to the Underwriters' Code. The fan shafts run on ball bearings.

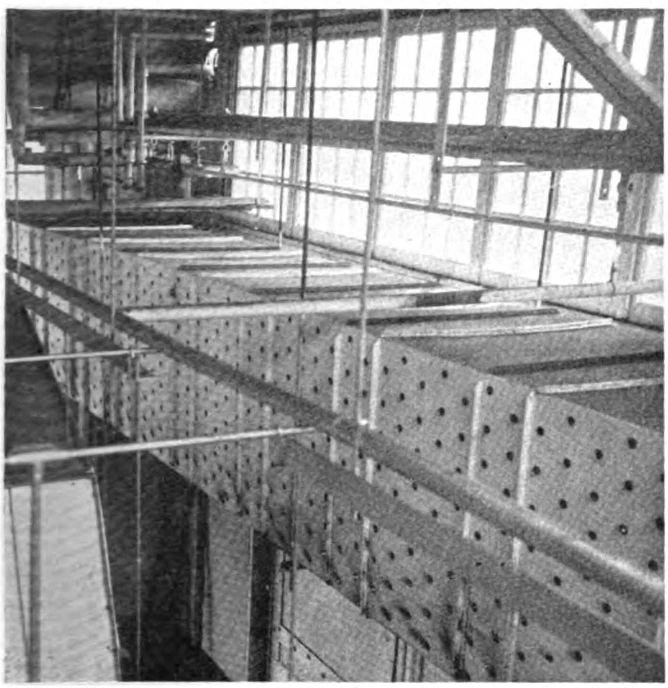
Air ducts of steel and concrete construction are utilized for forcing a current of air upward through longitudinal slots in the floor. These slots parallel the track and run the entire length of the canopies. The location of these slots and ducts can be observed in the illustration showing a sectional view of the spray room. Air for these ducts are furnished by four 7½-hp. explosion-proof motors directly connected to fans which circulate spray-room air. The narrow curtain of air from the floor slots passes upward between the car and the spray op-



case the air is passed over the car roof and upward through an opening, thence directly through the stack.

Spray-Room Lighting

As previously mentioned the south wall of the spray room is approximately 60 per cent window space and the roof bay above the canopy nearest the fire wall has windows on both sides for its entire length of 200 ft. General artificial illumination is furnished by 120 vapor-proof 300-watt lights, 30 of which are located at the edge of each side of the two canopies, the arrangement of which can be observed in several of the illustrations. These lights are mounted in vapor-proof reflectors at approximately 6-ft. intervals along the lower edges of the canopies. There are also six batteries of three 200-watt 75-ft. extension lights in the room which are used for interior car painting; these lights are enclosed in steel guards and vapor-proof glass protectors. All switches for the overhead and extension lights are controlled by explosion-proof toggle switches.



Duct at one end of the spray room which delivers filtered air from the shop heating system—This duct at the west end of the room, and a similar one at the east end of the room deliver 75,000 cu. ft. of air per min.

Control Circuits

Main switches for the operation of all motors and for the overhead lighting units are located adjacent to the heating room above section *C* of the erecting shop. They are controlled remotely from push-button stations placed in gangs at four points on the side walls of the spray room. The main switches can also be controlled manually at the switch, so that a maintainer, working on one of the motors, can disconnect the circuit at the switch without any danger of someone starting it from the push-button station.

Spray-Room Painting Facilities

The spraying facilities includes ten 5-gal., one 10-gal., and two 15-gal. spray tanks. The air pressure for the spray guns varies from 10 to 20 lb. at the tanks and from 40 to 60 lb. at the transformer which is the pressure at the head of the spray gun for atomizing the paint.

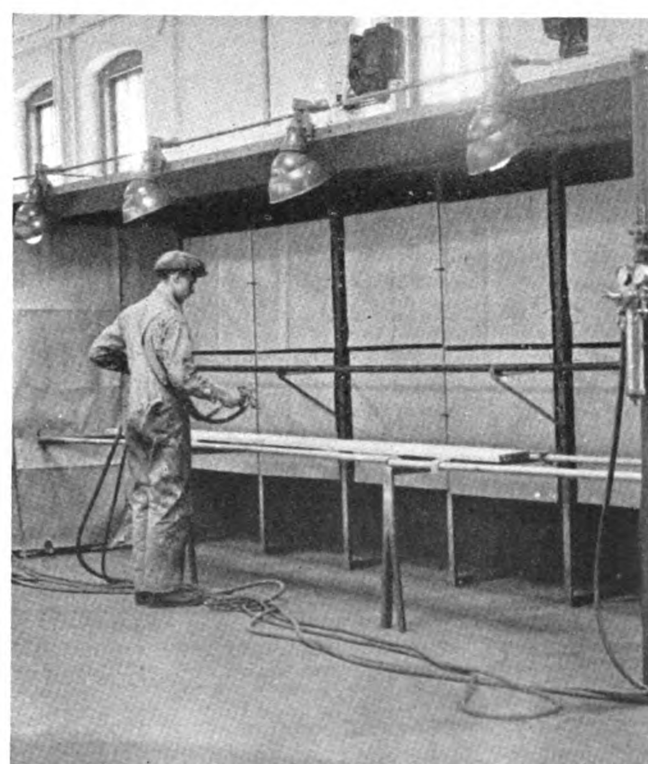
A self-propelled dolly, shown in one of the illustrations is used by the spray operators for painting the upper car exteriors. This dolly is of all-welded construction, and is fitted with four 6-in. rubber-tired wheels, one of which is provided with a sprocket wheel with a driving chain attached to a large driving sprocket mounted on the rail above the dolly platform. The spray operator can move and can guide this dolly by means of this chain drive and steering apparatus along the side of the car as the spraying proceeds. One of the wheels of this dolly is designed with a spring-actuated adjustment to prevent unbalancing or tipping of the dolly when it passes over floor irregularities; this arrangement is shown in one of the illustrations.

Sequence of Car Repair Movements

When a passenger car arrives at the shops it is stripped and if a complete paint job is required all old paint is removed and the car is placed in the spray room where a priming coat is applied.

All removable car equipment, including air-brake, electric and air-conditioning equipment, as well as upholstery, doors and windows are removed to various shops for repairs. Trucks are placed in a truck shop with a capacity of 12 car sets where they are dismantled and repaired.

After the cars are repaired they are moved from the erecting shop to a wash shop which has a capacity of eight cars on four tracks, where all operations incidental to preparing the car for painting are performed. The car is then taken outside the wash shop and the underneath parts are sprayed. Sheet-metal shields made to window size but with holes cut in the centers for ventilation purposes when painting the car interiors are applied in place of the sash. The car is then placed in section *C* of the erecting shop where puttying, knifing and sandpapering are done. The cars are then blown out and placed in the spray room for applying finishing



One of the individual spray booths in the trim shop—Each booth is equipped with exhaust fans, complete spray equipment and adequate lighting facilities

coats to both the interior and exterior of the bodies. In painting car interiors the wall surfaces are sprayed first, after which they are masked by hanging curtains from the side-plate molding; finishing coats are then applied to the ceiling. The window sill and side-plate molding are cut in afterwards with a brush. A passenger car is completely painted, including priming, knifing, puttying, sanding, surfacing and application of finishing coats, in five days. The average head-end car is completed in four days. The car is lettered, and two coats of clear penciling applied over the lettering in the trim shop while the car is being finish trimmed.

Work in the Trim Shop

The trim shop is equipped with cabinet shop and spray-painting facilities to permit complete reconditioning of all trimmings in that shop. The spray-painting facilities consist of two 20-ft. and four 8-ft. spray booth equipped with exhaust fans and vapor-proof lights for spraying small car parts such as luggage racks, sash, lighting fixtures, hardware, dining-car chairs, and all other trim.

After trimming, the car is completed by applying batteries, electric lights and shields, seat backs and cushions, and all hardware. The air, steam, water and electric systems are tested and the car is gaged, adjusted for height and weighed. Upon completion, the cars are delivered to the transportation department.

Wabash Expedites Triple-Valve Repairs

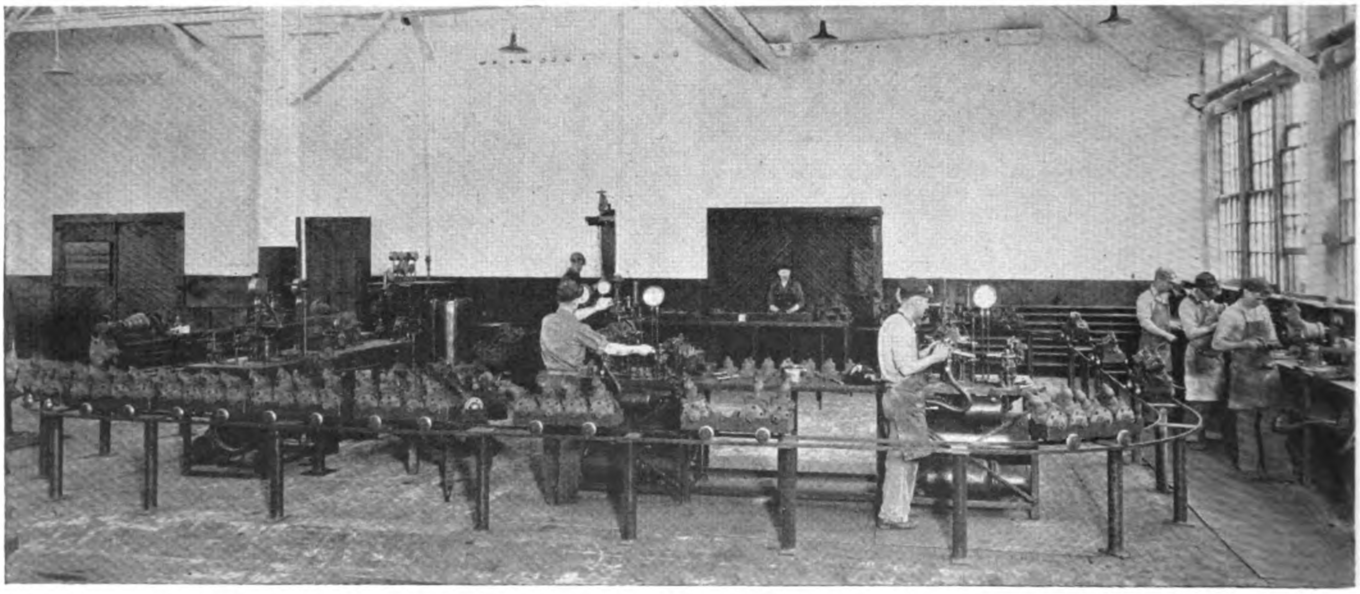
The fact that whenever repair operations are adequate in volume and sufficiently repetitive in character, railroads are not slow to organize them on a production basis, is nowhere better exemplified than in the case of triple-valve repairs as now handled at the Wabash shops, Decatur, Ill. Since June 1936, triple-valve repairs for the system have been handled in this modern air-brake room, a feature of which is the progressive movement of the valves in an orderly manner from one repair position to the next on small carriages which move freely and always in one direction on an elevated narrow-gaged track which extends entirely around the air-brake room.

This track arrangement is similar to that employed at the Sayre, Pa., shops of the Lehigh Valley, but has been changed in a number of particulars to adapt it to the space and other requirements peculiar to Decatur shops. For example, the floor layout is more compact, being included in a space 32 ft. long by 29 ft. wide in one corner of the shop. The main triple-valve repair bench is located against an outside wall with windows of ample area to admit plenty of daylight. In addition, the shop walls are painted white and supplementary light is provided when needed by eight 300-watt electric lights equipped with modern reflectors and suspended from the roof framework.

The track runway which surrounds the air-brake room is made of ½-in. by 1-in. rectangular steel rails, spaced 11 in. apart and welded on cross plates which are, in turn, welded to short vertical 3-in. pipe sections which support the rails 28-in. above the shop floor. The radius of the outer rail of this track at each corner is 6 ft. A 5-ft. bridged opening is provided for the entrance and exit of trucks and trailers loaded with triple valves.

The carriages, 16 in number, are made of ⅛-in. sheet steel cut out at the corners, bent and welded to form shallow boxes which are mounted on small wheels. Each carriage is 8½ in. wide by 28 in. long by 4 in. high, and is designed to accommodate four triple valves. As shown at *C* in one of the illustrations, four half-circles are cut in each side of the carriage to accommodate the triple-valve graduating stem nuts and the retarding device bodies, thus positioning the triple valves and allowing them to rest neatly in the carriage. The carriage wheels are equipped with Hyatt roller bearing wheels for greater ease of movement.

Equipment used in this air-brake room includes an air-motor-driven stripping machine *S* and work bench located inside the rail near the back wall; a long work bench with four triple-valve stands *T*, material bins, etc., under the windows; two 3-T test racks, equipped with counterweighted electric nut-tighteners *M* and separated by a 5-ft. work bench; a small capping bench; a third 3-T test rack *R*, available for use when necessary; work bench *W;* and *UC* test rack *U*. The stripping bench is



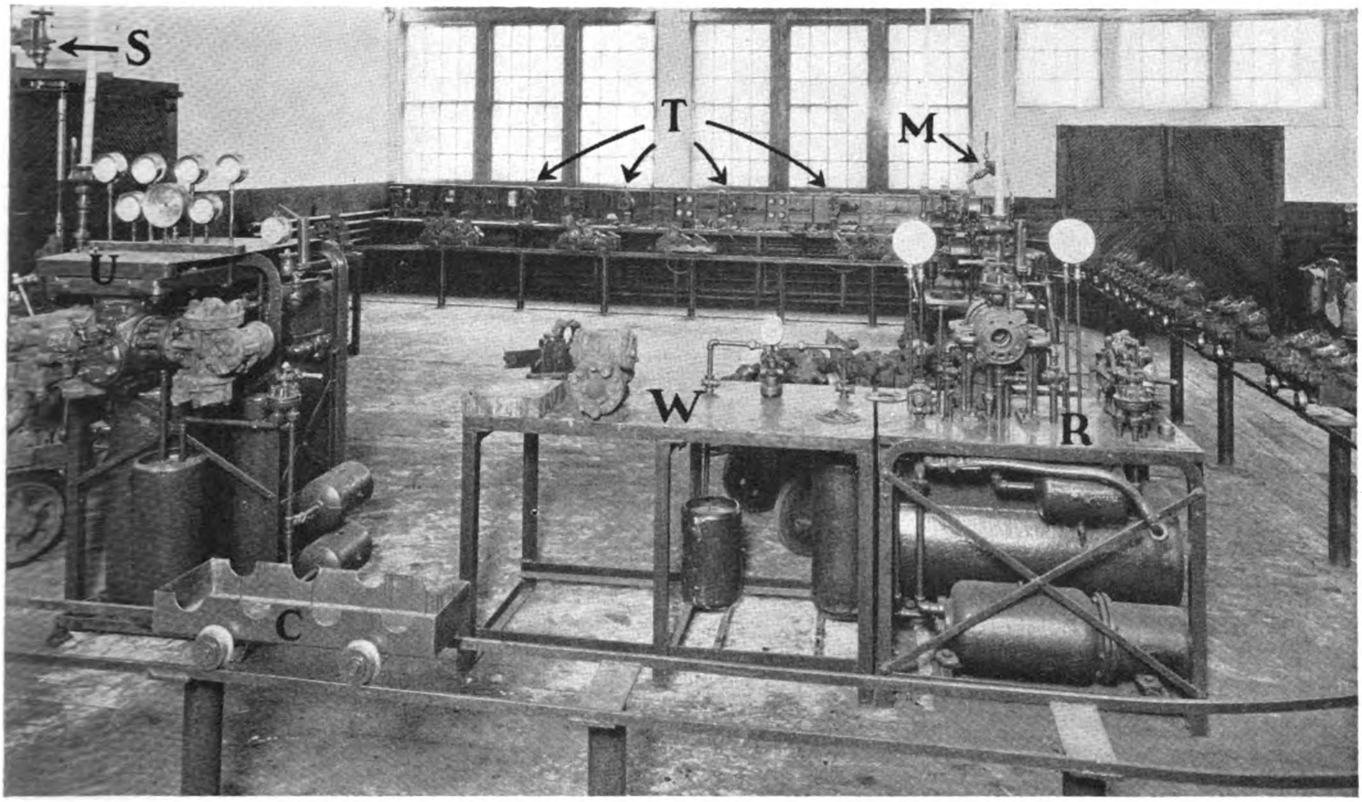
Modern-equipped air-brake room of the Wabash at Decatur, Ill., featured by excellent lighting conditions and the provision of a triple-valve carriage track

equipped with a nut-removing machine driven by air motor *S*, the drive shaft being provided with flexible and slip joints, and a head in which adapter sockets may be easily applied for the different size nuts used on cylinder caps. Similarly, at the two 3-T test racks most commonly used, a counter-weighted electric nut-tightening device *M* is provided which may be readily pulled down and used in tightening cylinder-cap nuts. An adjustable slip chuck on this device permits tightening nuts to exactly the desired tension without danger of stripping the threads.

In the operation of this air-brake room, triple valves are delivered on a trailer which holds about 40 valves, through the 5-ft. bridge opening in the rails. The triple valves are passed to the stripping bench where they are disassembled, blown out with air and all parts washed with kerosene. The cylinder-cap graduating stem and spring are gaged and if OK, the cylinder caps are sent directly to the 3-T test racks for subsequent assembly on the repaired valves after the feed-groove tests are made.

Other parts of the valves are loaded in the carriages and moved to a position opposite the triple valve repair stands. Here each cylinder is gaged and if beyond the predetermined limit of wear, held out for shipment to the manufacturer for the renewal of the bushing. If the bushing is in good condition, the piston ring is fitted and the slide and graduating valves spotted in accordance with the usual practice. A metal polish with exceedingly fine abrasive action is employed for all lapping and the use of files is prohibited. The check valve is ground in, a new rubber seat applied in the emergency valve and the check-valve case applied to the triple body, with a new gasket if necessary. The retarded-release parts are checked and the triple valve reassembled with the exception of the cylinder cap, then being replaced in the carriage for movement to the test rack.

The usual testing procedure is followed on the 3-T test rack where the first operation is to apply the feed-groove test device and make sure that the feed groove is within the desired limits of wear. On removal of the feed-groove testing device, the cylinder cap is applied, using the electric motor-driven nut-tightening device *M*. Other tests are made in accordance with the code of tests specified for this equipment. After testing, each valve is placed back on the carriage and moved to the capping bench, where a protection cover is applied and the valve loaded in a trailer for movement to the store room, and subsequent shipment to outlying points as needed.



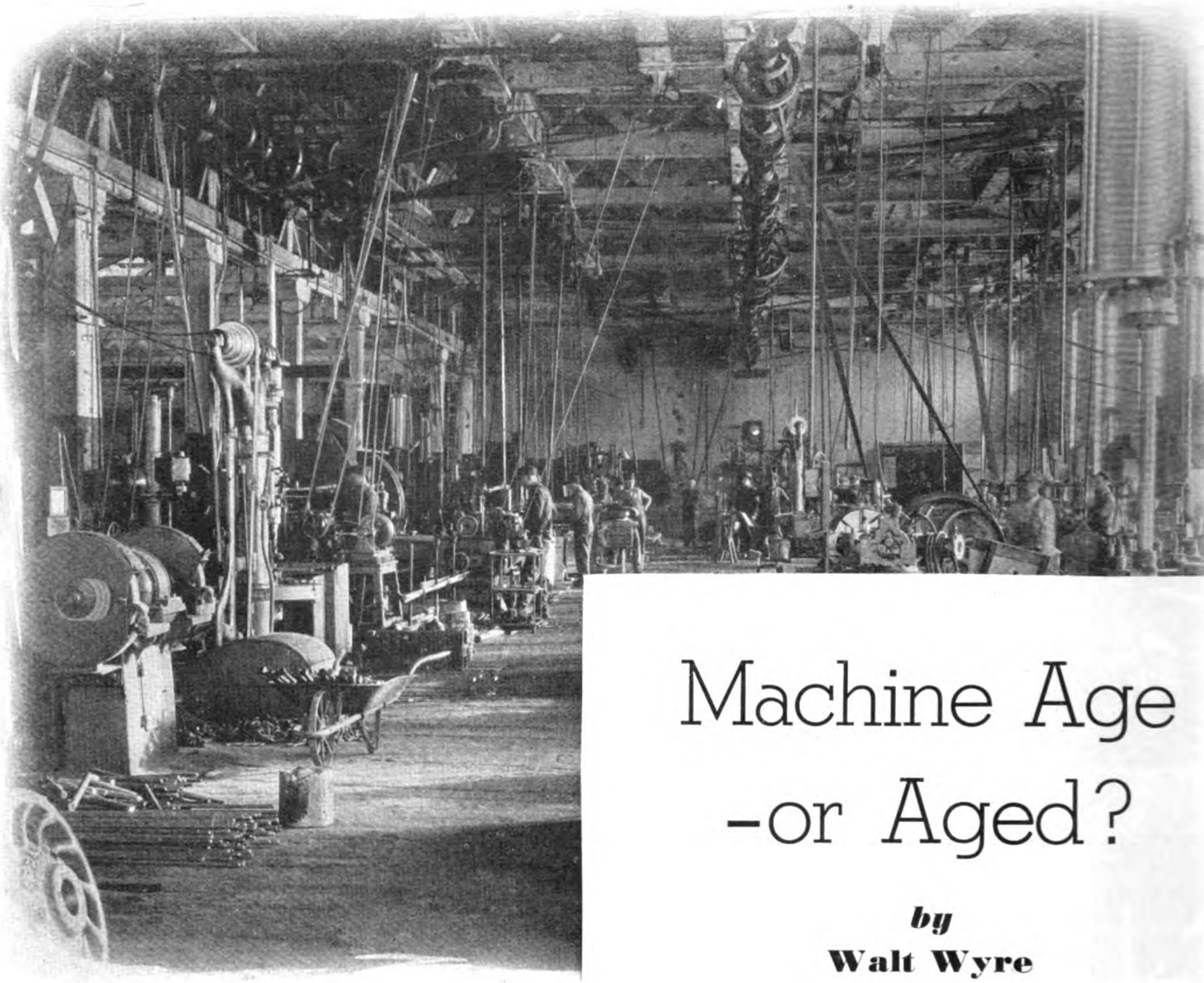
Track and carriage details are shown in the foreground of this view of the Decatur shop air-brake room of the Wabash

The production in this well-organized air-brake shop is dependent, of course, upon the demand for triple valves and the number of men employed. It may also be said that the number of valves repaired per man per day varies considerably, dependent upon the condition of the valves, some of which may be badly worn and others only slightly. The force usually employed at this shop consists of five mechanics, one helper and one apprentice. The output averages 80 valves per eight-hour day which includes complete overhauling, testing and capping ready for shipment.

* * *

PROGRESS.—Millions of words have been spoken and written about railroads, and among those which linger in the mind are a sentence or two from a speech M. W. Clement, president of the Pennsylvania, made some years ago. He said: "All I ask you to do is to watch the trains go by and you will say to yourself: 'Without any fuss, without any blowing of horns, here is an exemplification of the progress of American history; a progress just as great as that made by any other industry. Here is an industry—transportation—that has tied this country together from its very birth.'"

IN THE BACK SHOP AND ENGINEHOUSE



Machine Age -or Aged?

by
Walt Wyre

"Too much overtime, too many engine failures, too much material, too much valve oil, too many personal injuries," Jim Evans, roundhouse foreman on the S. P. & W. at Plainville, remarked as he thumbed through the pile of letters, traingrams, and messages on his desk. "Seems there's too much of everything but locomotives."

"Yeah, they are never satisfied," John Harris, the roundhouse clerk replied. "If locomotives ran on free air some of the big bosses would holler."

"The cost of turning engines here is pretty high, but blamed if I see how we can cut down any under the circumstances." Evans bit off a hunk of "horseshoe" and started to the roundhouse.

The 5087 that had just come in on a drag was standing on the lead. Engineer Hawkins who came in on her was looking the engine over. Evans turned and went to see what the engineer had to say about the engine.

Hawkins had plenty to say and he wasn't bashful about saying it. The booster wouldn't cut in except when going down hill, the water pump was on a sit down strike, valve and piston packing was down and the locomotive had less power than the Republican party last presidential election.

Evans listened to the engineer's recital of the locomotive's defects, spat reflectively, and asked: "Is that all that's the matter with it?"

"No, the air pump is lazy and she rides like a log wagon on cobblestones."

"O.K., we'll get her fixed up." Evans turned and started to the roundhouse.

"I forgot to tell you she don't steam good, either," Hawkins hollered at the departing foreman.

Evans stopped at the drop-pit to see how the 5090 was coming along. It wasn't coming, at least, not very fast. The two machinists and their helpers were giving excellent imitations of relief workers on a Saturday after-

noon. One of the nut-splitters was doing nothing; the other three men were helping him or vice versa; the foreman couldn't tell by looking.

"Waiting on machine work," one of the nut-splitters explained.

"Well, see if you can't find something that needs doing while you're waiting," the foreman told them. "If you can't, there's plenty of running repair work."

"Martin was starting to bore the driving-boxes when I was in the machine shop," the machinist replied.

Evans went to the machine shop to see why the delay. He knew without looking.

LIKE many other roundhouses, the machine shop at Plainville is like a car with sticking brakes in a train. Not only does it retard progress, but it takes more power to keep the whole thing moving. Most of the machines are antiquated heirlooms. Good machines in their day, like Model T cars, but not exactly suited for present requirements.

The machines in the shop at Plainville were not installed, they were accumulated. Each machine in the building represents improvement made at some other shop. Some of them saw service at many points before finally being sent to plainville as the last step to the scrap car, like a homeless aged person sent to the poorhouse to wait for the final call.

There is one difference with the machines, they don't idly wait for the call of the scrap car. True they are idle much of the time while repairs are being made or waiting for new parts while stores department officials frantically search files for name and address of the manufacturer that years before built the machine. In many instances, the genealogy of machines is a closed book. Like that of Father Divine, no one knows from where they came. In such cases, replacement of worn out or broken parts becomes a costly, tedious process of manufacturing without proper facilities.

When Evans entered the machine shop, he found everyone busy as ants before a rain. Martin had one of the driving boxes centered on the face plate of the boring mill. The machinist was on his knees beside the machine. Judging by the expression on his face, he was praying for the boring mill to fall to pieces—very small pieces—and scattered where no one would ever find them.

"What's the trouble?" Evans asked.

"The damned clutch!—every time I try to take a cut it slips, then when I want to stop the machine it sticks," the machinist said.

"Get it going soon as you can. The boys on the drop-pit are waiting for them driving-boxes."

At the big planer, Morris was planing a guide, but not according to one definition of planing as given by the dictionary: "to make smooth ——"

Evans looked at the serrated surface of the guide. "No wonder cross-heads wear out so quick! That's rough enough to cut all the babbitt off before it's made ten miles."

Morris, thinking he was being criticized, spoke up, "Yeah, it's pretty rough, but I'd like to see anybody do a good job with this outfit."

"Maybe we'll get a surface grinder for finishing them some of these days," Evans told him, but without much assurance in his voice.

King, another machine hand, with the aid of a chain fall hung from a beam overhead, two laborers and a helper, was centering a piston and rod in an antediluvian eighteen-inch lathe. It was necessary to "gap" the lathe to accommodate the piston.

At another eighteen-inch lathe nearby, a machinist was making the cuttings fly from a brass bushing. Some of the gears in the lathe had worn out and had been replaced with ones made by hand by drilling and filing the teeth. Those gears represented many hours of painstaking labor, but the teeth didn't mesh accurately and the lathe sounded like a Shay locomotive coming in with its last load of logs.

A stack of brass castings flanking the lathe told how far behind the machine work was. Evans took a fresh chew and went back into the roundhouse.

The drop-pit gang was still stalling, waiting for machine work. Evans told them to pull the pistons out of the 5087 while they were waiting. "I'll be down and look them over when you get them out," he said.

"Say, Mr. Evans, the 5066 has got a crack in the diaphragm plate," Joe Lynch, a boilermaker, panted. "She's called," he added.

Evans scratched his head abstractedly, then turned and started towards the lower end of the roundhouse. He stopped at stall 17 by the side of the 5091.

"How's she coming?" the foreman asked the inspector who was looking the engine over.

"Not bad, several little jobs, and there's way too much lateral on the main drivers," the inspector replied.

"Tell Carter and Cox to start working her. Got to use her right away in place of the 5066."

Evans checked the lateral between the wheel hub and driving-box of the left main driver. He shook his head and went to the other side. Hope vanished at first glance. He didn't need a scale to see that running the locomotive with that amount of lateral was nothing less than a bid for a Form-5 if a government inspector caught it—and the inspector assigned to that district must be a seventh son of a seventh son. If not clairvoyant, he's mighty accurate reading the present when it comes to Federal defects on locomotives.

Form-5's are about as welcome on the S. P. & W. as red ants at a picnic. They should be white instead of pink, because when a foreman gets one it makes him feel blue; when the master mechanic gets through telling him, his face is red, and everybody concerned gets "Hail Columbia" from the higher officials.

Evans was in a predicament. There was no other engine available for the fast fruit train and he didn't want to take too much of a chance.

Suddenly he turned and headed for the babbitt shop between a run and a walk. A pot of molten metal was bubbling on the fire. The babbitt man was getting ready to pour some cross-heads. He was testing the temperature by dipping a smooth pine stock in the hot metal when the foreman came in.

"How is it?" Evans asked. "About hot enough to pour?"

The babbitt man looked at the stick. "Just about."

"Get a piece of one-inch hose five or six feet long and bring a big ladle of metal down to the 5091. Tell Malone I said to help you. Have the babbitt good and hot."

"What you want us to do?"

"I'll be down there," Evans told him and went to the roundhouse office to tell the clerk to call the dispatcher and give him the change of engines on the fruit train.

Evans was waiting on the right side of the 5091 when the coppersmith and babbitt man got there. Malone, the coppersmith, was an old head and had an idea of what the foreman wanted done.

"Which one is it?" he asked.

"Right here," Evans replied. "Be sure the hose fits up good and snug. . . . Help him hold it in place," he told one of the machinists, "and put on your goggles."

When the hose was drawn up in place to close the outside of the gap between the hub and driving-box, Evans told the babbitt man to fill the space with the molten metal to take up the lateral on the right side. There was still enough lateral on the left side.

When cooled enough to set, the babbitt appeared to be stuck solid to the polished outside end of the main driving-box. A little chipping with a chisel smoothed the rough edges of the metal.

"Well, I hope it makes a trip without falling off," Evans said fervently when the job was finished and the hostler started backing the 5091 out of the house.

There wasn't anything called to run for a couple of hours. Evans went back to the office for a few minutes rest. While resting he could look over work reports, sign some requisitions for material, figure out the engine lineup, and read any mail that had come in.

The correspondence on his desk wasn't heavy, but it was hot. One letter in particular from the master mechanic quoting the superintendent of motive power intimated that from the number of bull rings used at Plainville they must think bull rings were bought at Woolworth's with special consideration for quantity. He further suggested that just because brass was yellow no one need think it came in bunches like bananas.

While the foreman was reading the mail, one of the machinists that had been working on the 5087 came in. "We've got the pistons pulled," he told Evans.

"How do they look?"

"Blowing pretty bad. Both sides will need new bull rings and the cylinders should be rebored; they're considerable out of round."

The cylinders were out of round, no denying that. Evans knew it before he calipered them. New bull rings would only correct the trouble temporarily.

"Well, you fellows go back to the drop-pit. Martin should have the driving-boxes finished by now."

Evans found machinist Cox and told him to bore the cylinders on the 5087.

The nut-splitter groaned and began to gather up his tools. Martin came by holding a pair of calipers like he had something on a stick that didn't smell good.

"How in the dickens can a man make bushings to fit when the pin and hole in the rod are as bad out of round as that?" The nut-splitter pointed with his thumb over his shoulder.

"What engine?"

"The 2768—main pin. I've made a new bushing every trip for the past two months and they come back pounded out," Martin said. "If we had a crank pin grinder ——"

"Yeah, I know," Evans interrupted. "If the pins were true, bushings would run better and last longer, but I don't see much chance of us getting a pin grinder; they cost a lot of money."

Evans felt like saying more. He felt like saying that pin grinders cost money, but so do bushings, and the labor putting them in adds up, to say nothing of delays caused by hot pins. Burning out worn pins and replacing them with new ones cost money too, especially with the facilities for doing it at plainville. Heating the wheel hanging a ram in place, an occasional miscalculation of expansion with a new pin sticking and having to be burned out—Evans thought of all that as he walked down towards the 5087.

Cox and his helper had with the help of two laborers lugged the cumbersome boring bar down to the locomotive and were setting it up. The helper had gone in search of an air motor while Cox centered the bar in the left cylinder. They were getting along as well as could be expected. The foreman went on through the house.

It was mid-afternoon when Cox got the boring bar all set and ready for the first cut in the cylinder.

Cox is about the only machinist in Plainville that has any luck with the old boring bar at all and sometimes he has a lot of trouble. The front end support has been broken and welded on one side and requires a washer of just the right thickness under it to line up. Hay wire is used to stay the air motor that runs the machine. When set up, the outfit looks like something Rube Goldberg might have constructed and works very little better.

Cox turned on the air; the bar started to turn. The feed wouldn't work. It took thirty minutes of tinkering and cajoling before the recalcitrant feed decided to cooperate and the cut was started. The tool bit into the metal; the air motor stalled. The machinist gave it a twist with his hand to start it again. That time it kept going, the tool chattering its way through. Evans came by and watched a few minutes.

Ten minutes later the air motor operating the boring bar quit cold. About that time the stationary fireman came in. He was looking for Evans. "The air compressor—it's broke down," the stationary fireman told the foreman.

Evans swore under his breath. "I don't see how they expect us to keep locomotives running with machines that need more work on them than the locomotives," he growled.

"What am I going to do about boring the cylinders?" Cox wanted to know.

"How you getting along?"

"A finishing cut will finish the left one."

Evans squinted one eye thoughtfully. "Well," he said, half to himself, "tell the hostler to run the 5074 in the stall next to the 5087. Use air from her reservoir to finish the left cylinder with. Better work overtime to finish it."

"What about the right one?"

"Let it go. We'll put in a new bull ring and packing. It'll run a few trips."

It would run a few trips—blamed few—and there'd be more letters "why so many bull rings, why so much valve oil, why so much overtime, why didn't locomotives make time with full tonnage." Evans knew it, but—locomotives have to run, so what the hell ——

Evans went to the storeroom to see if they had plenty of bull rings and bushings ordered.

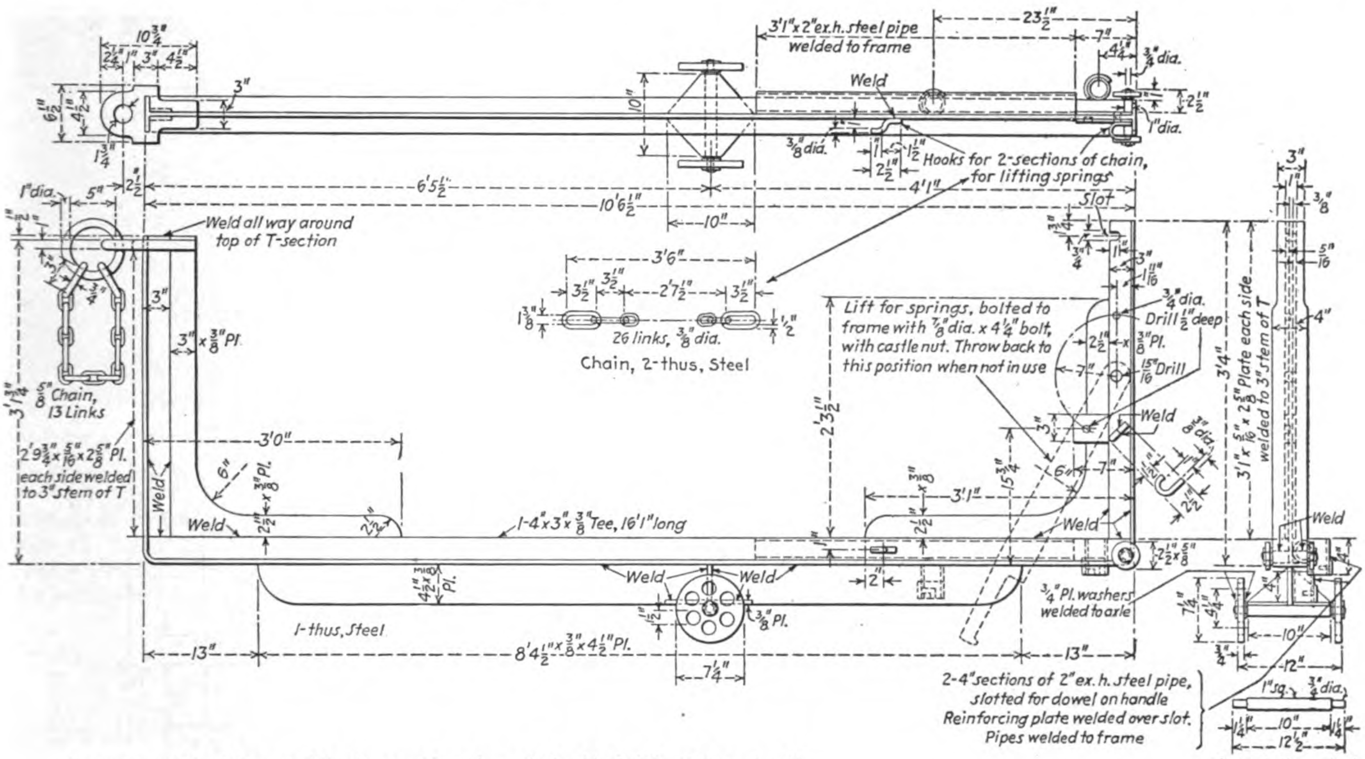
Combination Lifter for Locomotive Parts

A lifter incorporating a number of various attachments which can be slipped onto the device is being used in the erecting shop of the Norfolk & Western at Roanoke, Va., for removing and applying such locomotive parts as driving springs, expansion joints, high-pressure crossover steam pipes, stoker parts, cylinder heads, grate-shaker cylinders, lift shafts, valve-gear frames, power reverse gears, crossheads, and crosshead guides. The drawings show the lifter and nine of the various attachments, from which it will be noticed that the attachments can be quickly applied and removed. Other illustrations show the device in use. A handle made of pipe, which can be inserted and locked in either of two sockets in the back of the upright member of the lifter, is used to guide

the device. Wheels on the back of the upright member facilitate the rolling of the lifter about the shop without the aid of a crane.

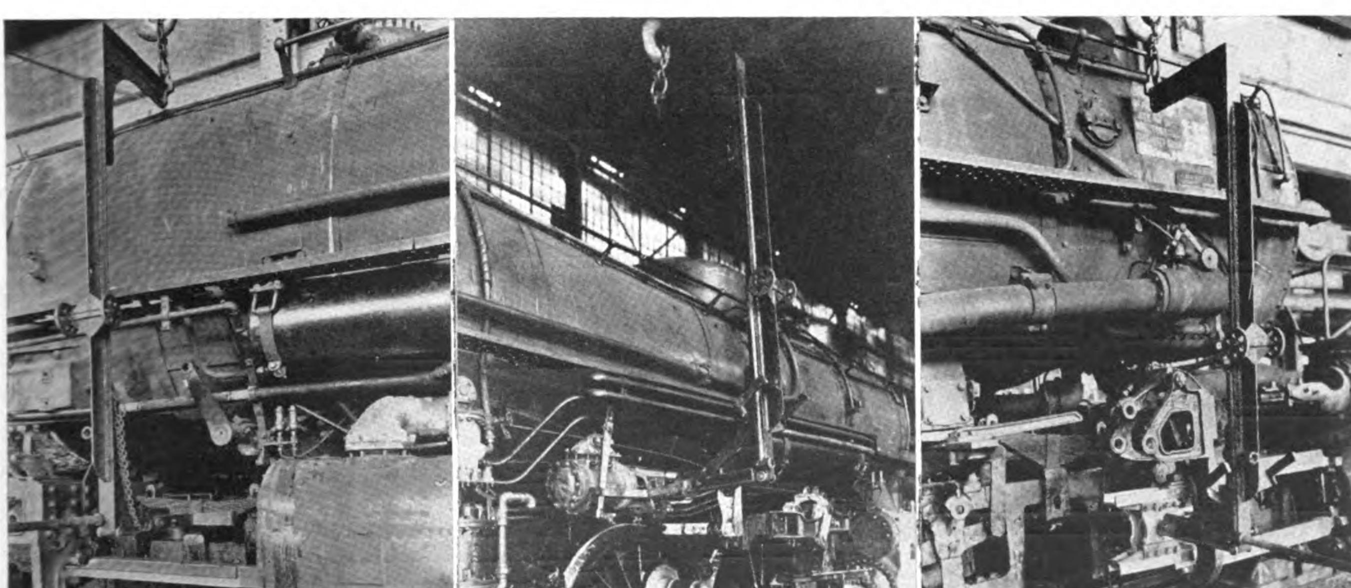
Attachment No. 1 is used for lifting Ragonnet power reverse gear. Attachment No. 2 is for lifting front cylinder heads, line shafts, crossover steam pipes, high-pressure steam-pipe elbows, and with an extension added is used for applying fire doors and stoker parts. Attachment No. 3 is for applying back cylinder heads. Attachment No. 4 is used for applying steam-pipe expansion joints.

Attachment No. 5 is for lifting driving springs, trailer springs and crosshead guides; this attachment is bolted to the lifter as shown in the assembly drawing of the device and can be turned back to permit the application of other attachments. Chains are used with attachment No. 5 for swinging driving springs under the lifter so that the springs can be hoisted over driving wheels. Section *AA* of attachment No. 5 shows a locking device to hold the attachment in or out of position when on the lifter.

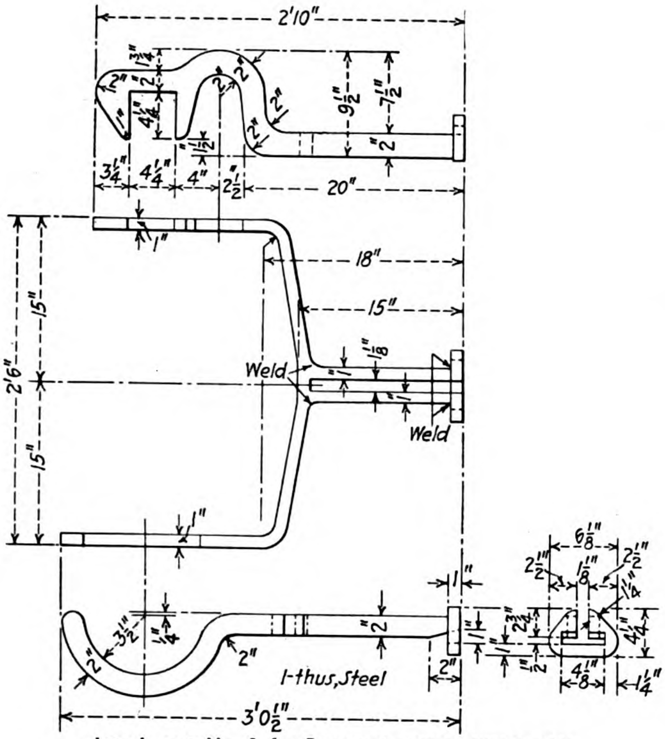


Assembly of the lifter used in the erecting shop of the N. & W. at Roanoke, Va.

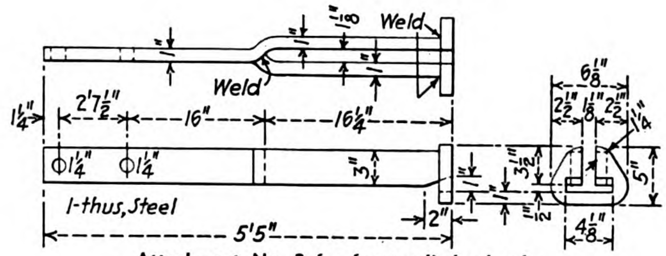
Attachment No. 6, of which there are two designs, is used for lifting Baker valve-gear frames. The slot at the end of the horizontal arm of the lifter is used for holding the No. 6 inside attachment in position. This slot is also used for blocking up spring-lifting attachment No. 5 by placing a bolt or other round stock in the slot under this attachment, thus raising it high enough to remove and apply driving springs behind valve-gear



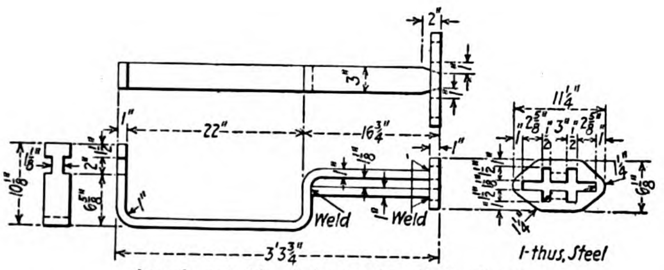
Left—Spotting a driving spring in position with attachment No. 5. Center—Ragonnet power reverse gear being applied with attachment No. 1. Right—Lifter with no attachment being used for applying a crosshead



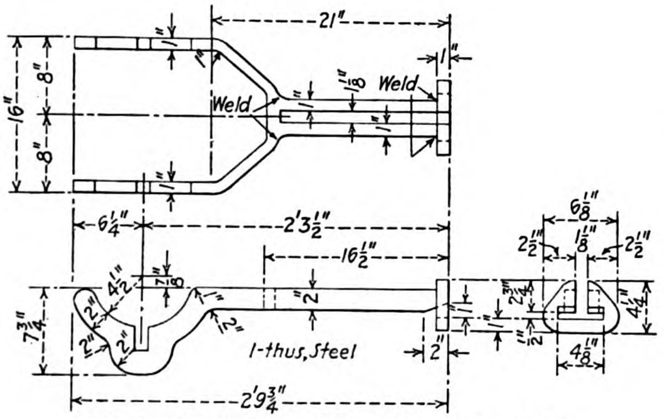
Attachment No. 1 for Ragonnet power reverse gear



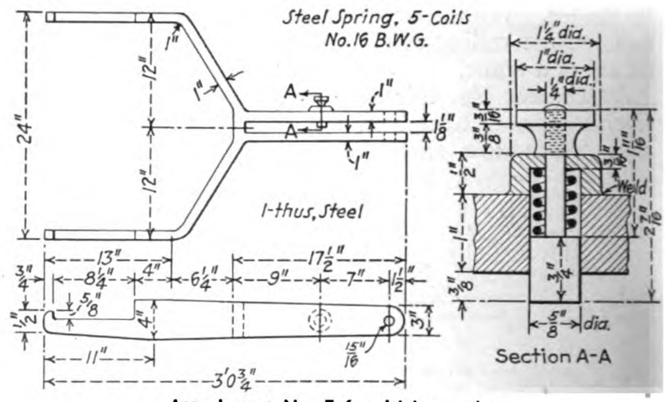
Attachment No. 2 for front cylinder heads



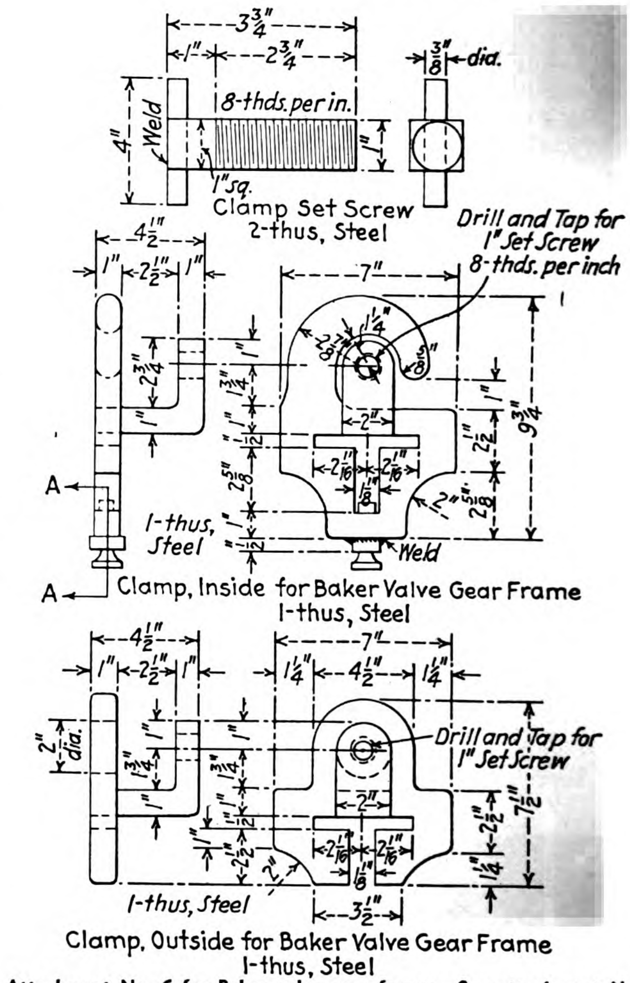
Attachment No. 3 for back cylinder heads



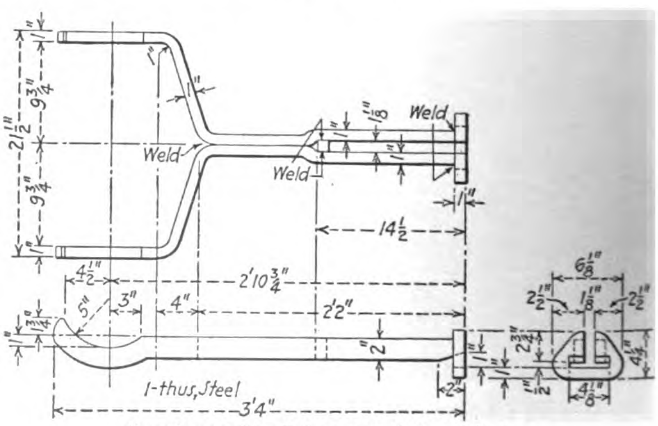
Attachment No. 4 for steam-pipe expansion joints



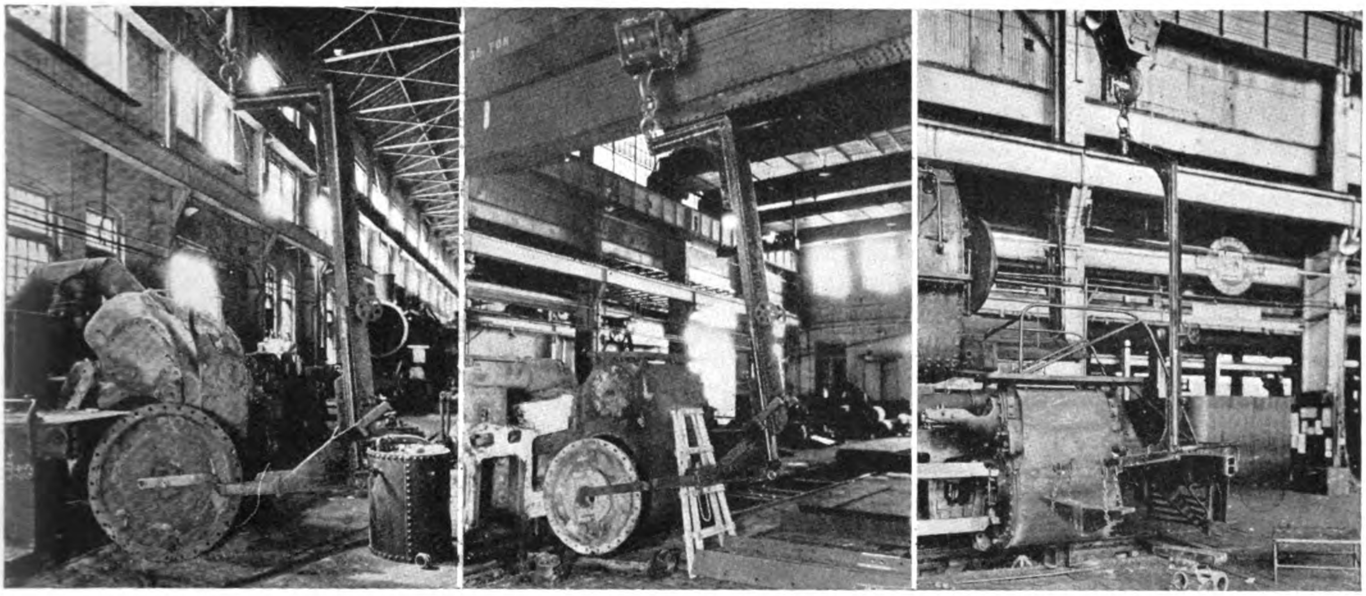
Attachment No. 5 for driving springs



Attachment No. 6 for Baker valve-gear frames—See attachment No. 5 for details of section *AA*



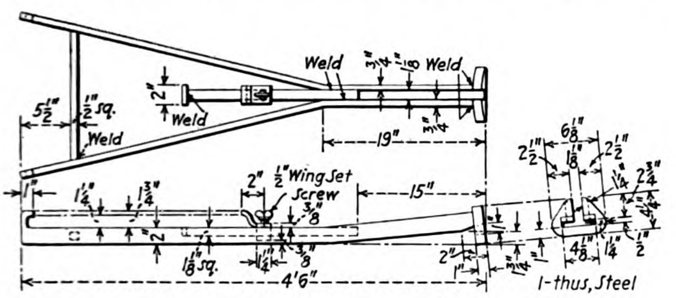
Attachment No. 7 for grate-shaker cylinders



Left—Front cylinder head being handled with attachment No. 2. Center—Front cylinder head being applied with attachment No. 3. Right—Lifter with attachment No. 5 carrying a driving spring suspended on chains for placing it behind a driving wheel

frames. A locking device used with this attachment, shown as Section *AA*, is the same as illustrated in the drawing of attachment No. 5.

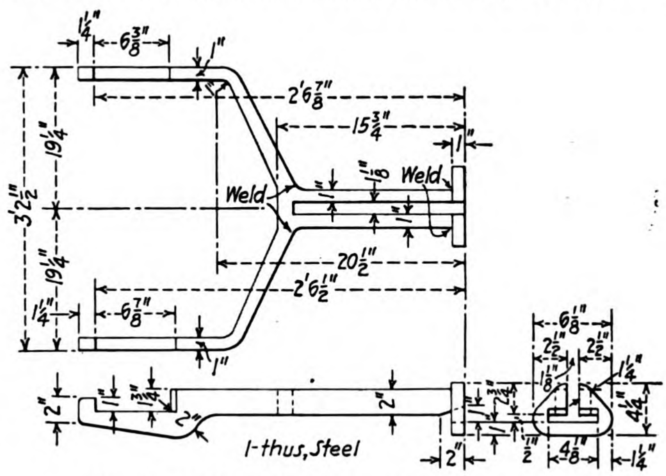
Attachment No. 7 is for lifting grate-shaker cylinders,



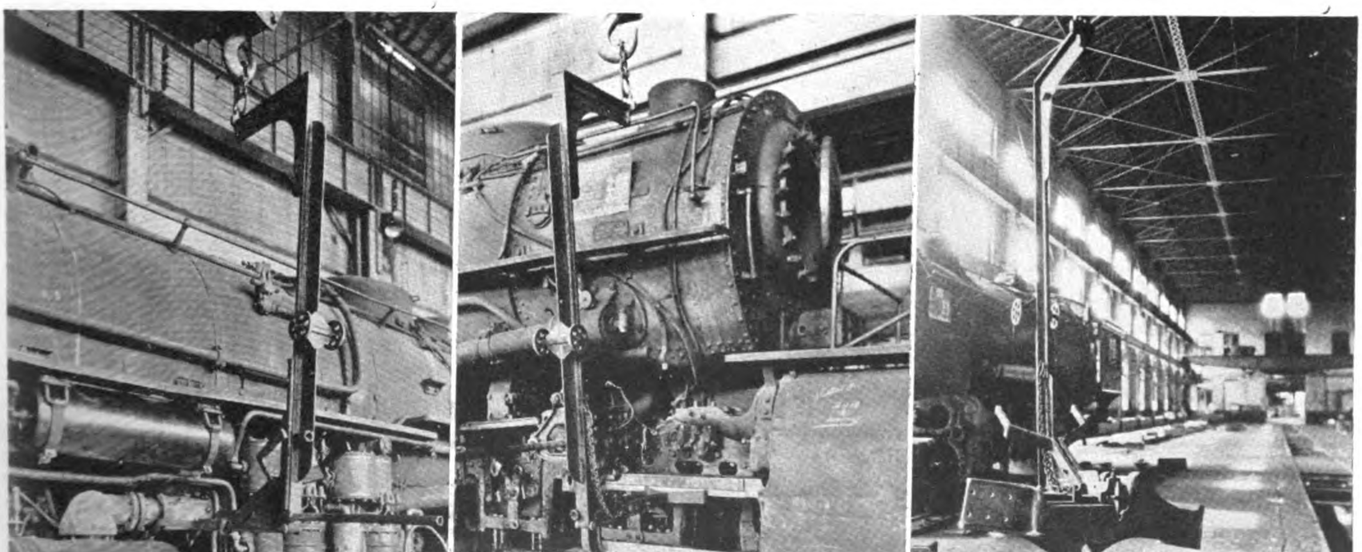
Attachment No. 8 for smoke-stack extensions

attachment No. 8 is for lifting smoke-stack extensions and attachment No. 9 is for handling the cylinders of Precision power reverse gears.

When applying or removing crossheads, as shown in one of the illustrations, no attachment is used with the



Attachment No. 9 for Precision power reverse gear



Left—Steam-pipe expansion joint being handled with attachment No. 4. Center—Applying a crosshead guide with attachment No. 5. Right—Baker valve-gear frame held on the lifter by attachment No. 6. Note attachment No. 5 swung back out of position

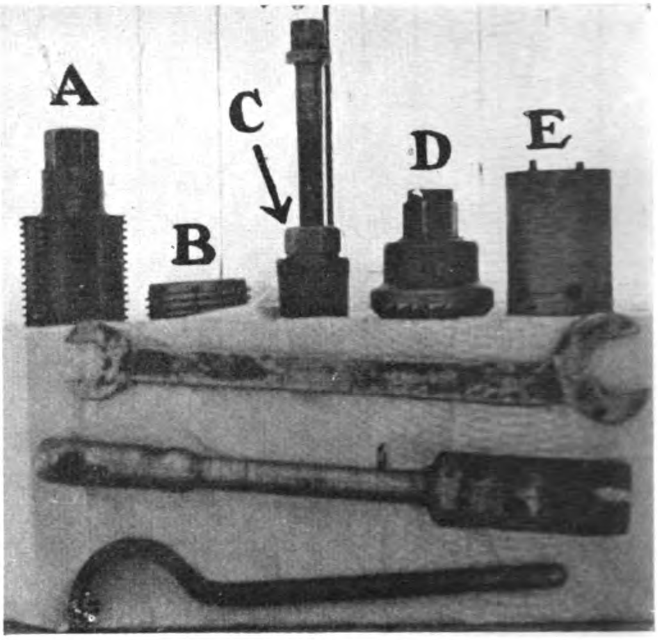
lifter, the horizontal member being inserted directly into the wrist-pin hole. In this view the guide handle is seen inserted in the lower socket; the upper socket for the handle is shown just below the wheels on the back of the upright member of the lifter.

All of the attachments slip on the lifter, and where necessary are held in place by locking devices shown in the drawings of attachments Nos. 5 and 6. The uses of attachments Nos. 1, 2, 3, 4, 5, and 6 are shown in the various illustrations. Uses of attachments Nos. 7, 8, 9, and 10 are not illustrated, but the captions of the drawings indicate their use. The lifter takes up very little space on the shop floor and can be readily moved about the shop by means of the wheels without the use of a crane. It has proved to be valuable in the erecting shop on the N. & W. as a safe and economical device for handling locomotive parts.

Arch-Tube Bushing Reamer

The arch-tube bushing reamer or facing tool, illustrated, is used at the Alliance, Neb., shops of the Chicago, Burlington & Quincy to save time and money and eliminate delays when arch-tube plugs leak. By the use of this tool, it is possible to refinish badly-pitted and leaking arch tube bushing seats smoothly, accurately and with a minimum out-of-service time for the equipment.

A tap *A* should be on hand or made to clean out boiler scale in the arch-tube bushing before applying the expanding nut *B*. Then screw the expanding nut into the arch-tube bushing and be sure it is about three threads below the face of the bushing so that the cutter will not cut into expanding nut and damage it. Next apply the hollow threaded taper plug *C* (7/8 standard USS thread inside) and then the dowelled barrel wrench *E* which is used, in connection with a spanner wrench, for holding the expanding unit in place while a long-handle socket wrench is applied to tighten the taper plug. After this is done, remove the dowelled barrel wrench and apply

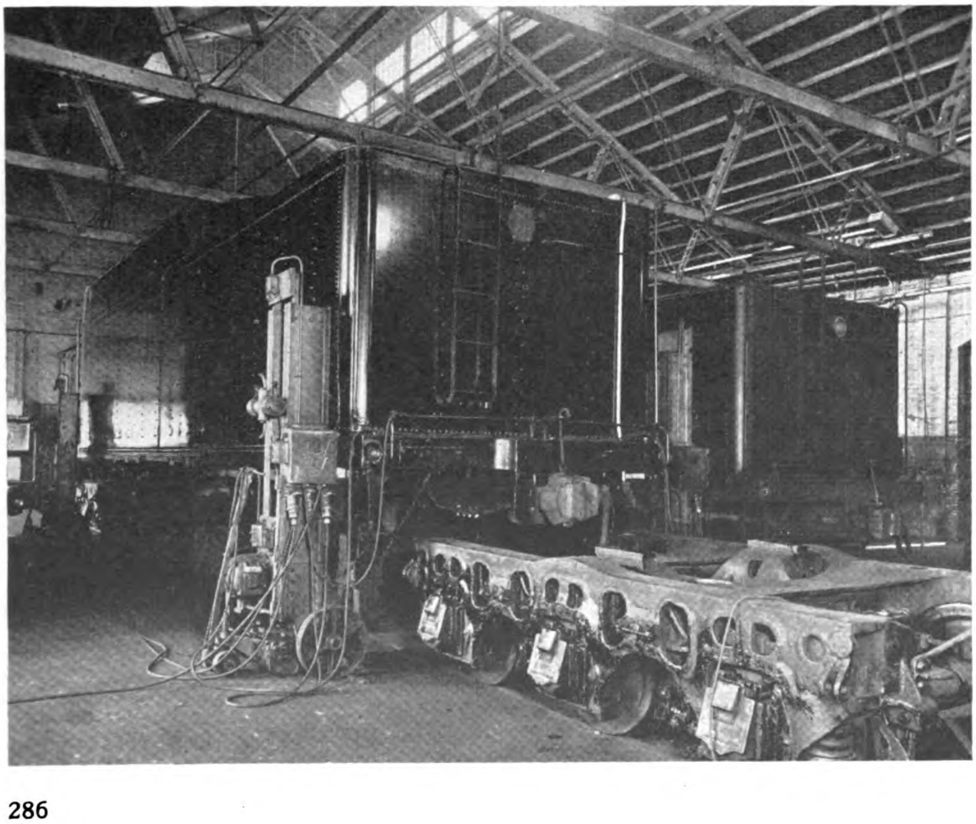


Parts of the arch-tube bushing reamer used in reconditioning bushing seats

the reamer *D*, a 7/8-in. by 6-in. stud or bolt being used to guide and tighten the reamer while operating.

For best results use a little cutting fluid while reaming and also keep the reamer sharpened to a keen edge. If necessary, a blank reamer may be substituted for the cutting reamer and the joint ground to a very smooth seat. In the illustration, the assembly of wrenches required to operate this reamer is shown below the various reamer parts.

* * *



Whiting Jacks Used in Tank Shops

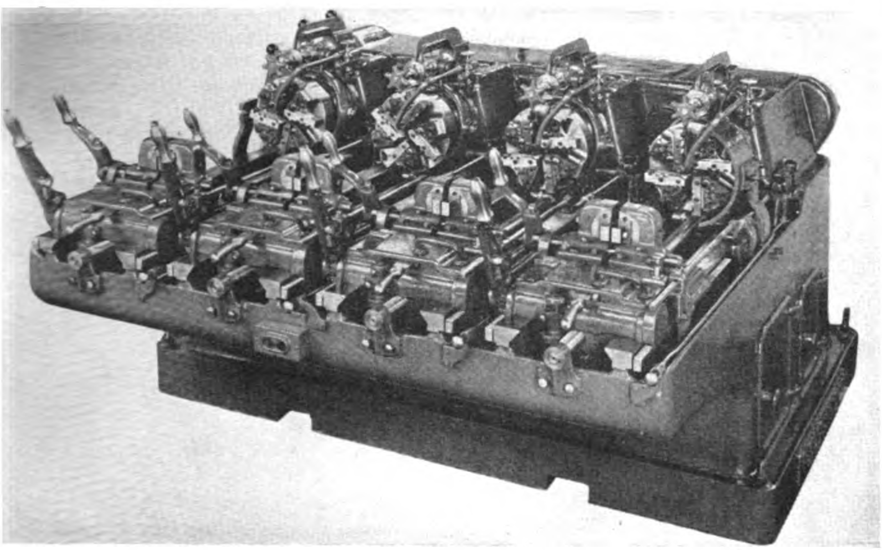
Whiting electric portable jacks have been used for years in sets of four at coach shops to raise cars for truck removal and application where cranes of sufficient capacity were unavailable, or where low roof height made the use of any traveling crane impractical. In the past few years single pairs have been utilized at coach yards to take the place of drop-pit tables when removing and applying trucks or single pairs of car wheels.

A more recent application of the jack is shown in the illustration, where a set of four units are used in a tank shop for raising heavy rectangular and Vanderbilt-type tenders. Since capacities, in sets of four, run from 100 to 140 tons, these jacks can easily handle these modern tenders. One jack, a pair, or two pairs can be operated from a single control station. These jacks also are in successful use handling electric locomotives for wheel removal, and but minor changes were necessary to make them applicable for their present use in locomotive shops. With present construction they can be used for raising Diesel-electric locomotives for truck removal.

NEW SHOP TOOLS AND APPLIANCES

Four-Head Staybolt Threading Machine With Tangent Dies

The illustrations show the Model 35 four-spindle staybolt threading machine developed by the Acme Machinery Company, Cleveland, Ohio. The machine is equipped with Acme tangent dies which are supported against the cutting action almost to their center line, this design being used to insure uniform and accurate diameters through the entire length of the thread. An adjustment feature operated by a star wheel, shown above the heads, is used to set the dies for different diameters of staybolts; this adjustment has a diameter range of ⅜ in. without stopping the rotation of the spindle. A dial graduated in thousandths of an inch directly behind the star wheel permits quick adjustment for accurately sizing diameters.

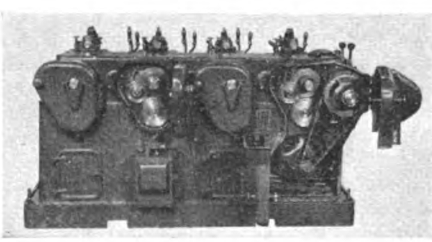


The Acme Model A four-spindle staybolt threading machine

The machine is equipped with an eight-speed quick-change gear box which is clutch controlled. All gears and shafts are of alloy steel mounted on preloaded Timken bearings running in oil. The vises can be adjusted in both directions, which feature permits lining up the staybolt with the center of the spindle. Other features of the machine include: A power-feed attachment; leadscrews to all spindles; a pitch indicator; double racks and pinions for actuating the carriages through an 18-in. travel; self-contained motor drive which is optional either through a silent chain or a multiple V-belt; hand and automatic trips to both die-head and leadscrew nuts; covered ways; telescopic cover over leadscrews; an automatically reversible coolant pump. Another feature of the machine is that both the bed and headstock are made from fabricated steel plate which does not change the contour over that of a casting.

The machine can be used for threading staybolts from ½ in. to 1½ in. in diameter at spindle speeds of 49, 62, 81, 102, 122, 152, 200, and 250 r.p.m. Power is furnished by a 7½-hp. motor which operates at 1,750 r.p.m. The machine weighs 8,000 lb. and occupies a floor space 80 in. by 82 in.

The Model 35 machine is designed specifically for production work, inasmuch as the independently operated die heads are



Rear view showing drive units of the Acme staybolt threading machine

so arranged that one or more are in operation while the vises or chucks of the others are being loaded. All controls, including those for making speed changes, are located to facilitate production work. An index placed on the front of the headstock indicates the proper position of the levers to obtain the desired machine speeds.

The Acme tangent die heads with which the machine is equipped can be adjusted by means of the star wheel above the headstock for controlling the size of thread diameters. On coarse-pitch threads where two or more cuts are required, the adjustments for the various diameters can also be made without stopping the machine. The graduated scale at the top indicates the exact position of the dies for the operator.

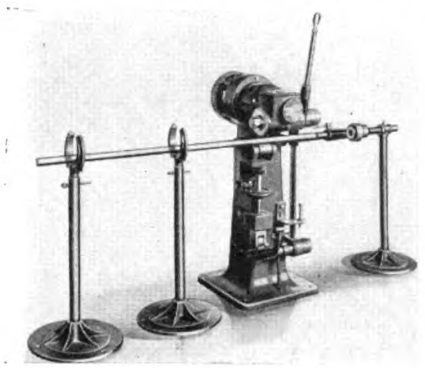
The die head is made up of a die ring, a barrel, a die slide, a die holder, a gage for setting dies, a die, and a die adjusting block. The die opening movement is radial and, on completion of the threading operation, the die is released radially from the cut without chip interference. The barrel supports the die, without overhang, almost to its center line. This construction makes for head rigidity and prevents the dies springing open on heavy cuts and eliminates one cause of inaccurate work. The die slide is a hardened tool-steel forging, accurately ground, operating in long hardened tool-steel bushings in the die rings and between the hardened and ground plates in the die barrel.

Upright Roller Pipe Cutter

A roller pipe cutter has been placed on the market by the Murchey Machine & Tool Company, Detroit, Mich., for cutting lengths of ½-in. to 2-in. pipe on a production basis. The machine, designated as the Murchey Model F pipe cutter, incorporates features of modern machine-tool design including a thin heat-treated steel cutting wheel capable of cutting off seven hundred 1 in. or twelve hundred ½ in. nipple blanks per hour. The cutter shaft of the machine is always in a fixed position and the rollers which support the pipe are raised to the revolving cutter by a combination hand and foot lever to save time and increase output. An adjustable stop is provided to limit the motion of the lever and pedal when cutting short pieces which do not require a full cycle of the cam which raises the roller cage to the cutter wheel. The rollers are of hardened tool steel and revolve in internal roller bearings. The cutter shaft is hardened and ground, and runs in Timken preloaded roller bearings. A gage bar for regulating lengths of nipples or pipe is supported by the column of the machine. This gage bar can be clamped to insure uniform length of nipples and is adjustable for all pipe sizes and all lengths within the ½-in. to 2-in. range of the machine. As an extra, a cage of smaller rollers can be fur-

nished to give the machine an added capacity for cutting ⅛-in. to ⅜-in. pipe. This cage of rollers can be placed in position without removing the standard roller cage used when cutting ½-in. to 2-in. pipe.

The machine is designed primarily as a motorized unit using a 2-hp. 1,200-r.p.m. motor mounted as an incorporate part of the machine with a direct drive to the cutter wheel; however, it can be furnished with cone pulleys for belt drive. The motor driven unit weighs 883 lb. and occupies a floor space of 20 in. by 20 in. Standard equipment consists of the previously mentioned standard rollers, one cutter wheel, a length gage, a gage stand, and three pipe stands. The machine is so designed that all roller cages, pipe stands, gages, etc., are interchangeable with the Murchey Model E pipe cutter.

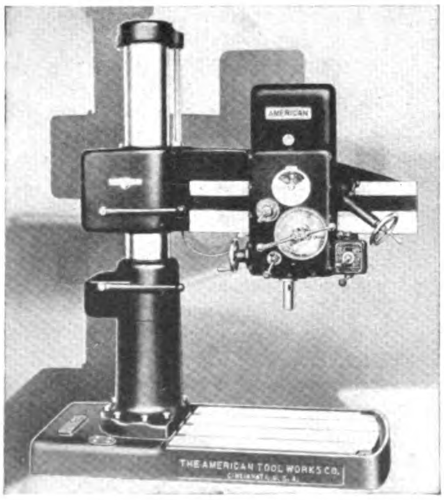


The Murchey Model F pipe cutter

Radial Drill For Precision Work

The illustrated drill, recently developed by The American Tool Works Company, Cincinnati, Ohio, and known to the trade as the "Hole Wizard" is designed for high-speed drilling, tapping, boring and facing operations. Accurate boring and facing is accomplished with the aid of stabilized spindle construction. The drive to the spindle is by means of hardened and ground helical gears. This provides a smooth power transmission to the spindle and a very quiet drive even at the highest spindle speeds. The spindle and spindle sleeve are made of Nitralloy steel, nitrided for extreme surface hardness. The spindle is ground to close limits and the sleeve is honed to precision limits. The hardening of these members permits of a much closer fit between the two, resulting in a precision mounting that lends itself to the most accurate drilling and boring for toolroom operations, die making and jig boring. The driving sleeve is mounted on Timken bearings at the top and bottom with means for take-up in case of wear. This insures not only a drive free from friction, but one whose original accuracy can be maintained for many years.

The Hole Wizard is offered in 3 ft. and 4 ft. sizes and in 9-speed and 12-speed types. It is driven by a built-in, high reversal, shell-type motor on the head and is equipped with a 9-in. diameter column.



The American "Hole Wizard" radial drill

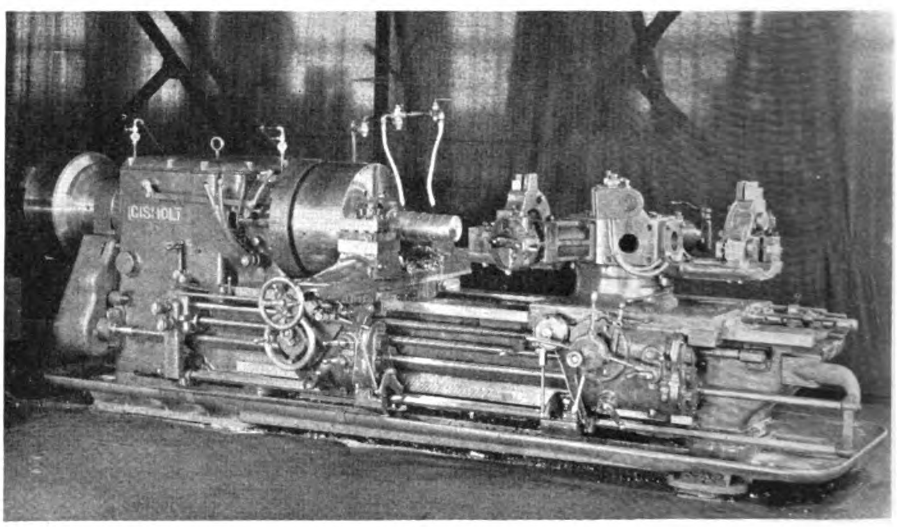
Machining Locomotive Crank Pins On a Turret Lathe

Machining crank pins, wrist pins and knuckle pins for locomotives is the work performed by the 4L heavy-duty turret lathe built by the Gisholt Machine Company, Madison, Wis., which is equipped with double hydraulic chucks and a fixed-center hexagon turret. Crank pins turned from forged alloy-steel bar stock can be machined at a cutting speed of approximately 60 ft. per min. when using high-speed steel tools and a cutting lubricant. The bar stock is held in two hydraulic chucks, one mounted on each end of the spindle. A three-jaw chuck is mounted on the rear end of the spindle and a six-jaw Duplex chuck on the front end. This chuck is really two three-jaw chucks built into one body with one set of three jaws located on the front face and the other set mounted in the chuck body near the back face. When the bar is too short to be held in both chucks, all six jaws in the chuck are used to hold the bar securely for machining. In this way the entire bar is used with a minimum amount of stock required for chucking purposes when machining the last piece in each bar. The duplex feature of the front chuck aids materially in chucking the short piece for the second machine operation described later.

Gisholt hydraulic chucks are adapted to this type of work because their design does not obstruct the spindle bore. Constant pressure to the jaws is another feature of the chucks because if the jaw teeth sink into the bar stock, the jaws automatically follow up, maintaining their grip on the bar and prevent slippage.

Crank pins, 7 in. in diameter and 14 in. long, are machined in two groups of operations. The order of machining in the first group is as follows: First, the bar stock is drawn forward to the desired distance by a bar gripper on one of the turret faces; second, all diameters are rough turned straight with a multiple-cutter turner which holds three cutters that cut simultaneously; third, the end is centered with a centering tool on one of the turret faces; fourth, two tapers are turned at the same time with the multiple-cutter turner; fifth, the end is faced and the small end is necked down before cutting off; sixth, the pin is cut off and caught in the bar carrier on one of the turret faces. The time for these six operations is less than 45 min.

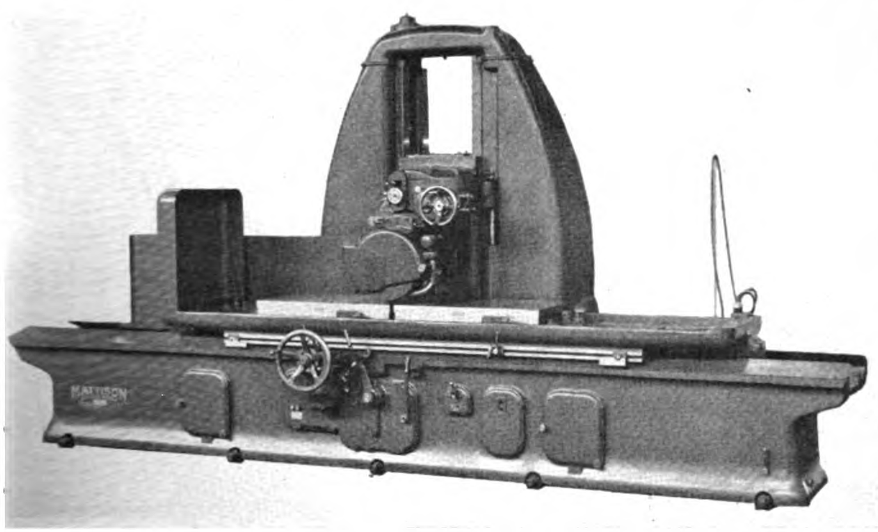
The order of the second group is as follows: First, chuck the pin on the straight diameter with soft jaws in the duplex hydraulic chuck; second, finish turn the small diameter and finish face with the square turret tool post; third, thread with a self-opening die head; fourth, drill a hole approximately 7 in. deep, counterbore, and tap, using a quick-change drill chuck on the turret face. The second group of operations is completed in less than 25 min.



Gisholt 4L high-speed turret lathe equipped with double hydraulic chucks and fixed-center hexagon turret

Precision Surface Grinders

The Mattison Machine Works, Rockford, Ill., is now offering the Mattison surface grinder with table widths of 12, 14, 16, 20 and 24 in., table lengths of 3, 4, 5, 6, 7, 8, 10 and 12 ft., hydraulic table feeds varying from 30 to 100 ft. per min., a built-in motor mounted directly on the driving wheel spindle, and two massive columns which support the wheel slide assembly without overhanging. The wheel head on all sizes of the grinder can be adjusted vertically to allow 16 in. between the table surface and the grinding wheel, which is 16 in. in diameter. The table has T-slots for holding the work on the table or for applying a supplementary table, special fixtures, or a magnetic chuck. The accompanying table lists floor spaces occupied by each of the machines. The five sizes of grinders all have grinding wheel guards, a wheel sleeve, a splash guard, base-leveling wedges, and a diamond tool holder furnished without a diamond.



The Mattison precision surface grinder

The motor of the 12 in. and 14 in. sizes has a rating of 15 hp. and can be furnished for alternating current of 220, 440 or 550 volts and operates at 1,200 r.p.m. on 40- or 60-cycle current and at 1,500 r.p.m. on 25- or 50-cycle current. The hydraulic, coolant and lubricating pumps for the 12 and 14 in. grinders are driven by a 5 hp. motor. The motor used for raising and lowering the wheel head has a rating of ½ hp. All motors are totally enclosed for protection against oil, water and metal dust. The wheel-spindle and pump motors are operated from a single push-button control station. The machine is equipped with a 30 gal. coolant tank, and the pump has a capacity of 20 gal. per min. The 16-in. grinding wheel has a 6-in. face, and a 5-in. hole, but can be furnished with a 10-in. hole. The cross-feed control is arranged for either hydraulic or manual operation; the transverse wheel-feed can be varied up to 1½ in. at each reversal of the table.

The motor of the 16, 20 and 24 in. grinders has a rating of 25 hp. and can be furnished for the same voltages and currents for speeds of 1,200 and 1,500 r.p.m. as specified previously for the 14 and 16 in. grinders. The hydraulic, coolant and lubricating pumps are driven by a 7½ hp. motor, while the one used for raising and lowering the wheel head has a rating of ¾ hp. The coolant tank with these three sizes of grinders has a capacity of 40 gal. and the pump has a capacity of 30 gal. per min. The wheel-spindle and pump motors are operated from a single push-button control station. The 16-in. grinding wheel has a 6 in. face and a 5 in. hole but can be furnished with a 10 in. hole if desired. The cross-feed control is arranged for either hydraulic or manual operation; the transverse wheel feed can be varied up to 1¾ in. at each reversal of the table.

Floor Space* of Mattison Surface Grinders

Table travel, ft.	Table width: 12 and 14 in.	16 in.	20 in.	24 in.
	Floor space, ft.–in. × ft.–in.			
3	5–10 × 10–0	....	....	....
4	5–10 × 12–0	....	....	....
5	5–10 × 14–0	....	....	....
6	....	7–6 × 18–6	7–10 × 18–6	8–8 × 18–6
7	....	7–6 × 20–6	7–10 × 20–6	8–8 × 20–6
8	....	7–6 × 22–6	7–10 × 22–6	8–8 × 22–6
10	....	7–6 × 26–6	7–10 × 26–6	8–8 × 26–6
12	....	7–6 × 30–6	7–10 × 30–6	8–8 × 30–6

* Including extreme travel of table at both ends.

Operating and adjusting levers, hand wheels, and electrical push buttons and switch levers are located on the front of all the machines, within reach of the operator. Raising and lowering the grinding wheel is controlled electrically by a push button located in the end of the clutch lever. With one movement, the motor is started and the power clutch is engaged. The downward movement of the wheel is controlled by a separate push button which is so arranged that the travel continues only while the operator keeps the button depressed. This enables him to spot the wheel just above the work. Final adjustment for grinding is made by handwheel and stop with micrometer graduations of 0.0001-in.

The reversing of the wheel-slide traverse is accomplished automatically, both on hand and hydraulic feeds, by two dogs on a circular disc and located directly in front of the operator. This mechanism also serves as a means for locating the wheel in the center of the work. The automatic feed can be disconnected and the hand feed used for shoulder grinding. A micrometer cross-stop device for positive regulation of the wheel movement can be furnished as extra equipment.

Sawing Machine With Selective Speeds

Another model of "Doall" contour sawing machine, just placed on the market by Continental Machine Specialties, Inc., Minneapolis, Minn., incorporates a dual dial control for indicating correct cutting speeds of various materials. The most important factor in narrow-band contour sawing is the correct speed of the saw for each material and for each thickness of job. To cut high-chrome, high-carbon steel the saw must travel at the rate of 50 to 75 ft. per min. To cut aluminum

Doall machine for selective narrow-band contour sawing of different metals

castings the saw must travel 400 to 500 ft. per min. Each different thickness of work and each different material necessitates a different sawing speed. The same is true in filing or polishing when the Doall machine is used for these functions.

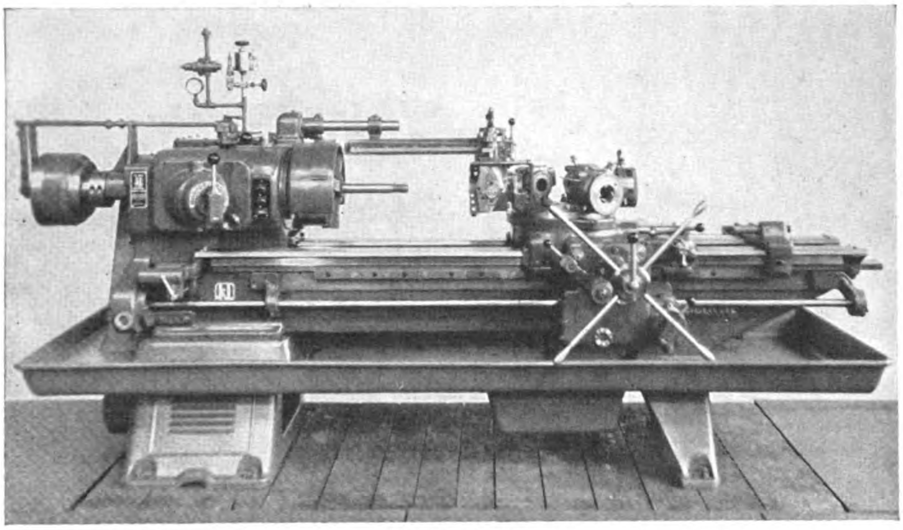
A dual-control dial is now built into the Doall machine, being mounted on the hinged door which is a feature of the model. After the manner of radio dial selections this dial lists 48 different materials. They are arranged alphabetically around the rim of the dial, beginning with aluminum and ending with zinc. This list includes several trade-marked materials, such as Monel metal, and, of course, all the common metals and materials. There is one blank space on the dial to permit the listing of any special material developed in the future.

In addition to dialing the correct sawing and filing speed, this control also translates the correct saw to use for each material. That is, it also shows the correct selection of saw as to pitch, temper and set for each of the 48 different materials.

Other improvements in this Doall contour machine are an improved lap grinder, a wider adjustment in the saw guide, and greater ruggedness throughout.

Machining Locomotive Tapered Bolts on a Production Basis

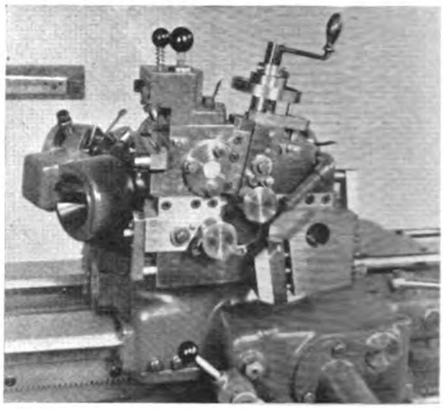
After analyzing methods for turning tapered locomotive bolts, the Jones & Lamson Machine Company, Springfield, Vt., has developed its turret lathes and tools to produce these bolts on a production basis. The unit developed for this purpose is the illustrated Jones & Lamson taper-bolt machine equipped with an air-operated three-jaw chuck for gripping the bolts on the hex head, a bell pointing tool, a taper turner for turning taper and straight diameters, and three automatic die heads which cover the majority of thread sizes on tapered frame bolts. The turret tools are arranged for three machining operations: First, the Bell pointing tool is used to square the end and point the bolt for turning; second, the taper turner is used to turn the body of the bolt, butt face the head, and turn the threaded portion straight to the desired thread diameter; and third, one of the three automatic dies is set to cut the required thread diameter.



The Jones & Lamson turret lathe for turning tapered locomotive frame bolts

The taper turner that is included with the machine will turn straight or taper diameters. The turner operates as follows: First, it is adjusted to a master plug which makes it possible to set the two supporting rolls and the tool in correct relation to one another. Second, the large graduated dial is set at zero, and to turn various sizes the operator opens or closes the turner to the desired size by reading the graduations on the dial. This makes it possible for the machine operator to turn bolts, on a production basis, to fit the reamed holes.

The taper is controlled with a template which can be made adjustable or solid. The taper template controls the two supporting rolls and the tool, so that, as the tool travels up the taper, all three points open up according to the adjustment of the taper template. With this turner it is possible to turn tapers the same as you would turn a straight diameter with a standard roller turner or box tool. The two supporting rolls follow the tool and produce a rolled finish. The template can be disengaged while the turner is at any point on the work for turning straight portions of the bolts.



The turret head of the J&L lathe—The Bell pointer is shown at the left, while the cutting tool and rolls are shown in the center

After the bolts have been removed from a locomotive frame, the holes are reamed until they clean up. No attempt is made to ream the holes to the same size. A taper plug gage is used for measuring the holes after they are reamed. The taper is 1/8 in. per ft. so that it is possible to obtain an accurate reading of the large end of the hole. The plugs are all lettered according to size and graduated from 1 to 10.

A chart, shown in Table I, is used for translating the reading on the plug gage to a decimal dimension so that the machine operator can turn a bolt to fit the hole that has been reamed and gaged. As an illustration, if the hole is measured with plug *A* and it drops into the hole to line *8* the decimal size of the bolt adjacent to the head should be 1.100 in. to obtain the necessary drive fit. It has been found in practice that the operator can disregard the small end of the taper and

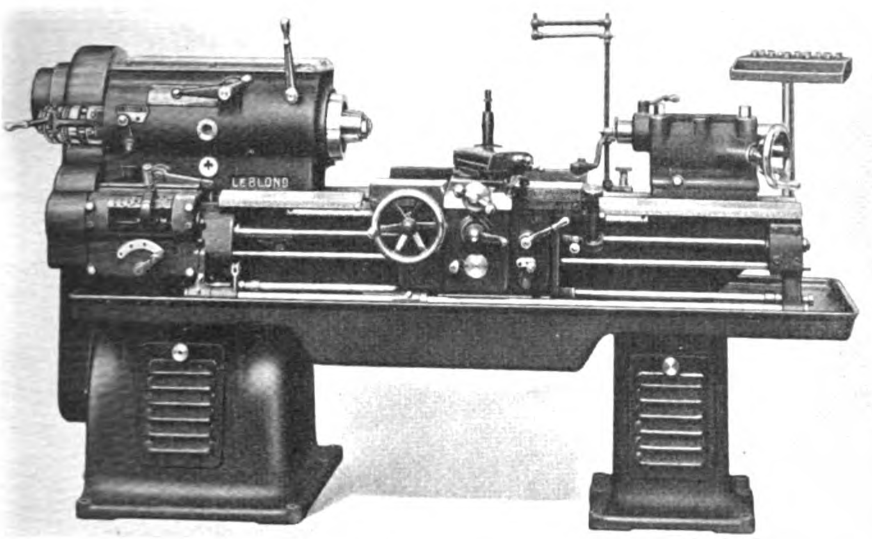
Table I—Plug Gage Classification and Limits

Gage No.	Gage Limits A	B	C	D	E	F	G	H	I	J	K	L
10	1.1250	1.2500	1.3750	1.5000	1.6250	1.7500	1.8750	2.0000	2.1250	2.2500	2.3750	2.5000
9	1.1125	1.2375	1.3625	1.4875	1.6125	1.7375	1.8625	1.9875	2.1125	2.2375	2.3625	2.4875
8	1.1000	1.2250	1.3500	1.4750	1.6000	1.7250	1.8500	1.9750	2.1000	2.2250	2.3500	2.4750
7	1.0875	1.2125	1.3375	1.4625	1.5875	1.7125	1.8375	1.9625	2.0875	2.2125	2.3375	2.4625
6	1.0750	1.2000	1.3250	1.4500	1.5750	1.7000	1.8250	1.9500	2.0750	2.2000	2.3250	2.4500
5	1.0625	1.1875	1.3125	1.4375	1.5625	1.6875	1.8125	1.9375	2.0625	2.1875	2.3125	2.4375
4	1.0500	1.1750	1.3000	1.4250	1.5500	1.6750	1.8000	1.9250	2.0500	2.1750	2.3000	2.4250
3	1.0375	1.1625	1.2875	1.4125	1.5375	1.6625	1.7875	1.9125	2.0375	2.1625	2.2875	2.4125
2	1.0250	1.1500	1.2750	1.4000	1.5250	1.6500	1.7750	1.9000	2.0250	2.1500	2.2750	2.4000
1	1.0125	1.1375	1.2625	1.3875	1.5125	1.6375	1.7625	1.8875	2.0125	2.1375	2.2625	2.3875
0	1.0000	1.1250	1.2500	1.3750	1.5000	1.6250	1.7500	1.8750	2.0000	2.1250	2.2500	2.3750

take all measurements at the large end adjacent to the head. As previously explained, all bolts are turned to the desired size by reading the graduated dial on the taper turner.

Tool-Room Lathe Redesigned

Realizing that economy in the production of tools and fixtures in the tool room is just as essential as the resulting product that must be built by the use of these tools and fixtures, economy in operation was primarily one of the important factors considered in the design of the illustrated tool-room lathe manufactured by the R. K. LeBlond Machine Tool Company, Cincinnati, Ohio. The lathe is being manufactured in 12-in., 14-in., 16-in. and 18-in. sizes.



The redesigned LeBlond tool-room lathe

The headstock of the lathe has a heavy heat-treated nickel-steel spindle rolling in antifriction bearings of large diameter. The spindle is supported at short intervals with a center bearing to minimize any tendency toward deflection at the spindle nose. All of the heat-treated gears are cut and ground to produce a quiet smooth-running gear train. The reverse gears and compounding gears have been removed from the end of the lathe and built inside of the head, eliminating troublesome hanging brackets and change gears, and simplifying changing of these gears by two handles on the front of the headstock. Automatic lubrication of filtered oil is furnished to all bearings; a sight-feed indicator is used to check the oil flow.

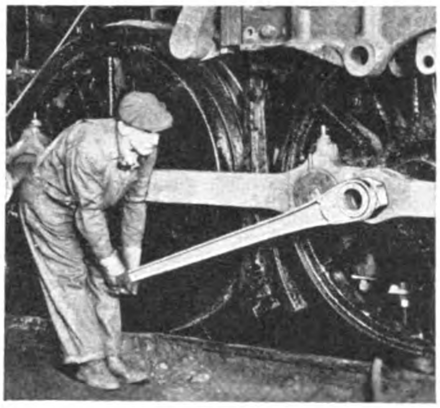
The one-piece double-wall box-type apron has been simplified so that the operation of the carriage and cross slides is performed with a minimum of effort and movement on the part of the operator. One lever controls the movement both of the carriage and cross slide. For thread chasing a central position of the feed-control handle releases the dog that locks the half nuts out of engagement. One-shot lubrication is provided through a plunger pump that forces oil to the apron bearings, the cross-slide and the bed ways. With the improved leadscrew reverse the direction of the carriage can be changed with the use of either the leadscrew or the feed rod without changing the direction of rotation of the spindle. A lever on the right side of the apron shifts the single tooth clutch in the thread and the feed gear train that controls the direction of the rotation of the leadscrew and the feed rod. With the leadscrew reverse, more accurate threads can be cut, since the single tooth clutch insures an accurate register between the leadscrew and the lead being cut. Adjustable automatic stops are provided to disengage the feed mechanism in both directions. When the stop disengages the leadscrew at the end of the thread it is only necessary to back the tool out of the thread and return it to the starting point where another stop disengages it. The tool is then set to the proper depth and the control handle is again engaged.

The feed and thread control mechanism, with all shafts on antifriction bearings, also has been simplified with a minimum of control levers to make all feed and thread changes through the entire range of 56 changes on the 12-in. and 14-in. lathes and 63 changes on the 16-in. and 18-in. lathes. The precision leadscrew is held between the ball thrust bearings on each end of the screw so that it is in tension when cutting right-hand or left-hand threads.

The conventional type of right-angle drive tailstock has been redesigned to increase its general usefulness. The extra long spindle now has a full-length bearing in the tailstock body even when the center is well extended, and the hole through the spindle is exceptionally large, making it possible to pass the bar stock through the tailstock and headstock spindles. Spindle movements of the tailstock is effected by a rack and worm, forming a positive lock to the spindle against backing out. The travel is greater than would ever be needed for a piece held between the centers and adequate for most drilling and boring operations without reclamping the tailstock screw. The position of the hand wheel at an angle on the front of the tailstock makes it easy to operate. Attachments are available for all types of general tool-room work.

Reversible Ratchet Wrench

Heavy-duty reversible ratchet wrenches with quadruple pawls instead of the usual two, with drop-forged handles, and with both hex and square sockets with the hole extending clear through for turning nuts on any length of bolt are recent additions to the line of wrenches manufactured by J. H. Williams & Company, New York, N. Y. These wrenches, called "Superector," have been fitted with the quadruple pawls to provide double bearing and increase the strength of the tool. The handles are drop-forged to utilize the extra



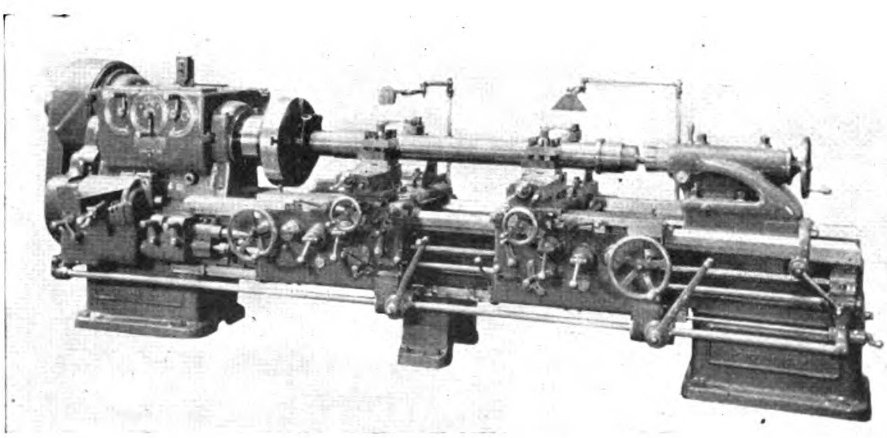
"Superector" socket wrench

strength afforded by the pawls. The wrenches have openings from 1 1/16 in. to 4 5/8 in. and are made in five sizes from 24 in. to 53 in.

High-Speed Piston-Rod Lathe

The American Tool Works Company, Cincinnati, Ohio, has developed the high-speed piston rod roughing and finishing lathe shown in the illustration. This is a 24-in. heavy pattern lathe which swings 27½ in. over the bed and is driven by a 25-hp. motor, either constant or adjustable speed. Two offset carriages are provided to permit two cuts on the work to be taken simultaneously. Each carriage has control of the spindle through a mechanical apron control unit, and is equipped with front and rear tool rests for holding multiple tools. One carriage is provided with a taper attachment for machining the crosshead fit.

In order that this lathe may be used



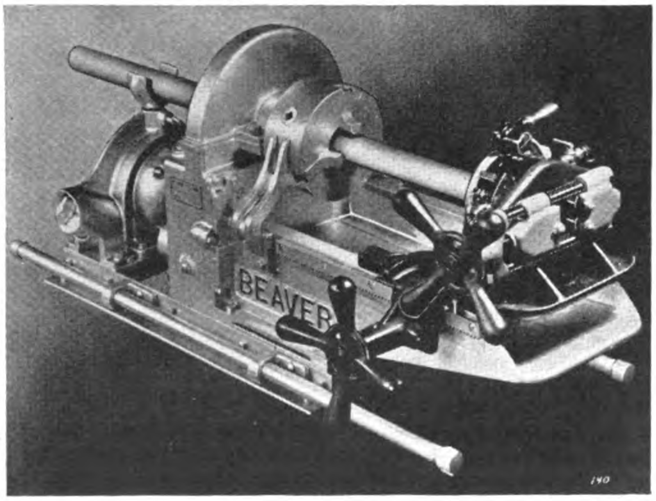
The American 24-in. piston-rod lathe

effectively with either high-speed steel or cemented carbide cutting tools it is equipped with a high-speed antifriction geared head which provides spindle speeds suitable for either type of cutting tools. The head mechanism is oiled automatically by means of a pump circulating system and the entire transmission is made of alloy steel, hardened, ground and lapped. The shafts are heat-treated and the multiple splines are ground in the latest spline grinding machines. To provide for the high cutting speeds permitted by cemented carbide cutting tools, the work supporting tailstock is made extremely massive and rigid with a large-diameter spindle and an antifriction center built into the spindle on Timken bearings.

The 25-hp. motor is mounted on a substantial pedestal attached to the rear of the head end cabinet leg, and is connected to the head driving unit by multiple V-belts.

Portable Unit for Cutting and Threading Pipe, Bar stock and Bolts

The illustrated portable machine for cutting and threading pipe, barstock and bolts is now being offered by Beaver Pipe Tools, Inc., Warren, Ohio, with the choice of either wheel-and-roller or automatic-knife cutoff, in addition to the standard features of rack-and-pinion feed, quick-opening fully adjustable die heads, full ⅛-in. to 2-in. threading range, and right-hand operation. The unit, designated as the Beaver Model A cutting and threading machine, is equipped with a heavy-duty Universal motor to operate on any 110-volt, 25 to 60 cycle circuit; it can also be furnished with a 220-volt motor. The motor, reversible through switch control, is mounted in the base of the machine and is connected by means of a flexible coupling to a heavy-duty helical all-gear drive.



The Beaver Model A cutting and threading machine now equipped with either wheel-and-roller or automatic-knife cutoff

Other features of the machine include: An automatic chuck-wrench ejector as a safety feature should the operator forget to remove the chuck wrench; an outboard pipe support which is adjustable for centering the pipe and for preventing the whip of long pipe lengths; adjustable quick-opening die heads of the solid ring type the four units of which move as a unit to insure uniform adjustment and even distribution of cutting on all four segments; a thread length indicator; a multi-fluted cone reamer for removing pipe burrs.

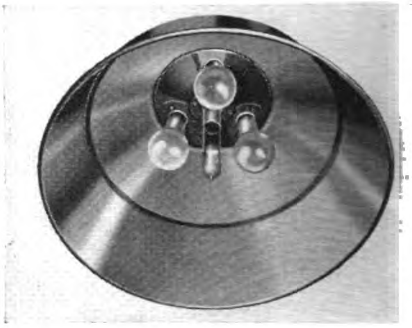
The wheel-and-roller cutoff cuts ⅛-in. to 2-in. pipe and ⅜-in. to 1-in. solid round bars. This cutoff is fed manually by a star wheel at the operator's right hand. It cuts 2-in. pipe in from 10 to 12 sec.

The automatic-knife cutoff cuts ¼-in. to 2-in. pipe, but will not cut solid round bars. The cutting knives, which are operated by a star wheel, have a safety guide ahead of the cutting edge to control the depth of the cut and to prevent hogging in. Self-centering V-jaws support the pipe and prevent chattering while cutting. The knife blocks are backed up by heavy springs to cushion the shock and prevent knife breakage when cutting out-of-round pipe.

The machine is sufficiently powerful to cut and thread 2½-in. to 12-in. pipe with Beaver geared tools and drive shaft. It is furnished either with sliding handle bars or mounted on a wheeled under carriage.

Mercury-Mazda Lighting Units

For industrial lighting where color correction is necessary, a combination 250-watt mercury-mazda lighting unit has been announced by the Westinghouse Electric



Combination mercury-mazda lighting unit

& Manufacturing Company, East Pittsburgh, Pa. Designed for mounting heights of 8 ft. to 18 ft., these units mix the light lumens of the mazda with the mercury lamp, giving the required color correction.

Two distinct circuits are used; one to control the mercury lamp and one to control the mazda lamps. The design is such as to allow three 60-watt, three 75-watt or three 100-watt mazda lamps to be used without interfering with the restarting of the mercury lamp in case of a voltage interruption. The unit consists of an aluminum reflector, with socket assembly and a Monax diffusing hinged glass bowl. The reflector is made from 14-gage commercially pure aluminum sheet of etching grade. The entire surface is Alzaked for greater permanence and ease of cleaning.

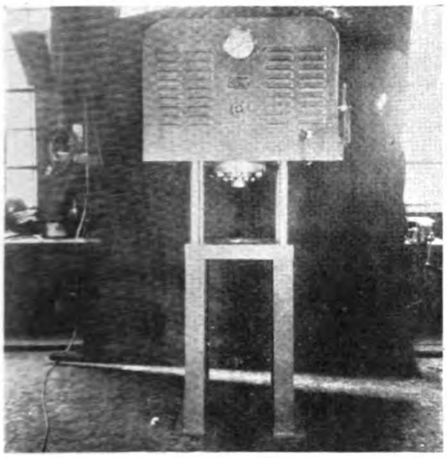
The socket assembly which consists of three medium sockets for the mazda lamps and one socket for the mercury lamp is attached to the top of the reflector. A slip-type louvered cover provides sufficient ventilation for the sockets and allows for wiring or inspection of wiring after the reflector is in position. It is arranged for mounting on ½-in. conduit. The diffusing bowl is banded at the fitter and hinged in the reflector. A felt gasket forms a joint between the glass and the reflector. The

entire assembly is simple to wire and the hinged glass bowl makes the lamps easily accessible and eliminates the hazard of removing large globes. Sufficient ventilation is provided to keep the temperature within safe operating limits.

Reverse-Cylinder Bushing Press

The illustration shows a self-contained cylinder bushing press with the hydraulic power unit mounted on the top platten. This power unit consists of a high-pressure variable-pressure piston pump of the rotary type, an electric motor, and the operating valves. The movement of the ram is controlled by means of a single lever which actuates a four-way operating valve.

The press has a capacity of 20 tons with an operating pressure of 2,000 lb. per sq.



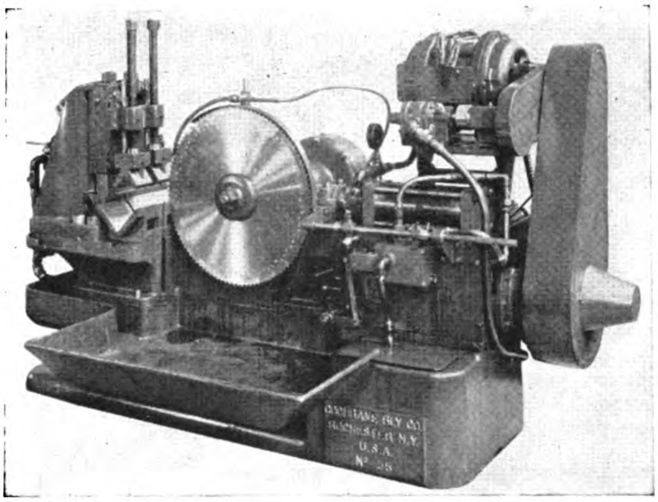
The Watson-Stillman 20-ton bushing press

in. on a 5-in. diameter ram which has a stroke of 10 in. The plattens are 16 in. square, with a vertical opening between the plattens of 12 in. The press, mounted on legs to give a distance of 3 ft. 4 in. from the floor to the face of the bottom platten, is the product of the Watson-Stillman Company, Roselle, N. J.

Hydraulic Saw For Non-Ferrous Material

The illustration shows a high-speed hydraulic cold saw for the cutting of non-ferrous tubing and bars. It has a four-speed sliding gear transmission through hardened alloy-steel gears, hardened steel worm and phosphorus-bronze worm gear, running in oil. All drive shafts including the saw spindle are mounted in antifriction bearings.

Remote control is provided for changing the saw cutting speeds from 235 to 600 ft. per min. and the hydraulic feed is adjustable from 0 to 60 in. per min. The machine has an automatic trip, rapid return of carriage and rapid forward traverse of carriage. Adjustable stops regulate the travel of the carriage to the size of tube being cut. The machine has a hydraulic-



The Cochrane - Bly hydraulic cold saw

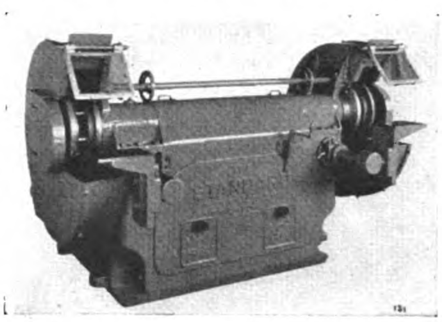
ally operated vise with compound toggle link and vertical slide carrying adjustable clamp screws each side of the saw blade. These screws are fitted with removable V or radius blocks to prevent distortion of thin-walled tubing under clamping pressure.

An extended pan provides large storage space for chips and permits the easy access of a shovel for their removal. A tank for hydraulic oil is located under the base of the machine, and the base provides a sump for the drainage of cutting oil.

The machine is motor driven through multiple V-belts, and has a friction clutch for instant stopping and starting. It weighs 5,000 lb. and has a capacity for cutting tubes up to 8 in. diameter in 80 sec. The machine is the product of the Cochrane-Bly Company, Rochester, N. Y.

High-Speed Snagging Grinder

The Standard Electrical Tool Company, Cincinnati, Ohio, announces that its No. 50 high-speed snagging grinder is now



The Standard No. 50 high-speed snagging grinder

available as a single-speed machine to take 30-in. diameter by 4-in. face by 12-in. hole grinding wheels to operate at 9000 surface ft. per min. The machine is powered by 15-hp. 900 r.p.m. ball-bearing motor located inside the base. Power is transmitted to the grinding spindle by V-belt drive. The guards are made of fabricated boiler-plate steel and are adjustable to the wear of the grinding wheels. The spindle has an overall length of 74 in. and is 4 in. in diameter. The net weight of the No. 50 grinder is 4,100 lb.

This same machine is available to carry 20, 24 or 30 in. diameter wheels with provision for increasing the grinding spindle speed to maintain 9000 surface ft. per min. on the grinding wheels.

Stationary and Traveling Hoists

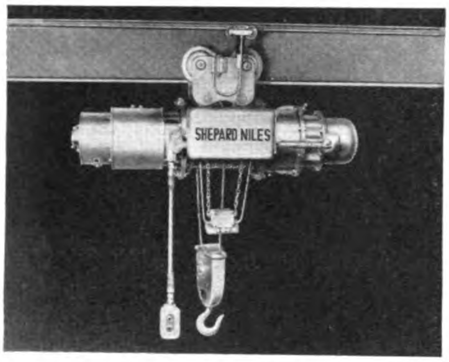
The Shepard Niles Crane & Hoist Corporation, Montour Falls, N. Y., recently placed on the market electric hoists designated as the "LiftAbout" which can be furnished as a stationary unit, as a traveling unit with a push, geared, or motorized trolley, as a unit with a top hook for hanging it in various locations, or as a unit which can be applied to carriers of different types of tramrail systems. All of these units with the exception of the stationary type can be furnished in different sizes with capacities ranging from the 250 lb. to 6,000 lb. and with lifts varying from 18 ft. to 30 ft., depending upon the type of drum used. The stationary type can be furnished with capacities varying from 125 lb. to 3,000 lb. and with a winding capacity of 36 ft.

The LiftAbout hoist is applicable wherever it is necessary to raise the load hook as close as possible to the underside of the I-beam from which the hoist is suspended. The hoist frame is cylindrical in form supporting rigidly the moving parts of the hoist, insuring permanency of alinement and quiet operation. It also forms a dust and moisture-proof enclosure for all the operating mechanism. The hoist gearing consists of a double train of heat-treated spur gearing, machine cut from forged alloy- or high-carbon-steel blanks. The driving pinion, which is an integral part of the motor-shaft extension, drives the gear train at two points diametrically opposite, thus balancing all stresses. Roller bearings are used throughout.

A multiple-disc mechanical load brake holds the load when the motor is at rest, and prevents excessive speed in lowering. It interposes no resistance in hoisting, and in lowering it offers only sufficient resistance to control the load. It will set when-

ever the load tends to descend at a speed slightly greater than that corresponding to the speed of the motor. Adjustments are made from the outside. A multiple-disc electric brake serves to bring the motor promptly to rest whenever the current is interrupted or cut off intentionally. It is connected in the motor circuit and is always set unless held off by current flowing through its windings. Adjustments are made from the outside.

The splined winding drum is machine grooved and has its flanges guarded. The hoisting rope is dead-ended to the hoist frame by means of a safety anchorage. The load block is of the safety type. Rope sheaves operating on roller bearings are guarded by a steel enclosure of a form avoiding any wedging action between the



Shepard-Niles "LiftAbout" Crane

enclosure and the rope. The load hook is of heat-treated steel and is arranged to swivel on ball bearings.

The electric motors for either a.c. and d.c. power are manufactured by the Shepard Niles Crane & Hoist Corporation for use exclusively with the hoists. Direct-current motors are series wound and are provided with commutating poles. Alternating-current motors are of the high-torque polyphase induction type, with either wound rotor or squirrel-cage winding, according to the type of control specified.

All motors are fully enclosed and rated at 30 min. full load with a 55-deg. C. rise.

The motor controllers are designed and manufactured for hoist service, in single-speed and multiple-speed types, operated either by push button or pendant ropes. Single-speed push-button magnetic controllers are furnished with two Shepard Niles contactors with mechanical interlock.

Multiple-speed push-button magnetic controllers provide five independent hoisting or lowering speeds by one push button. All speeds are under full control of the operator. An emergency stop switch, arranged to open all circuits is provided. The controllers operated by pendant-ropes are self centering. The hoists are provided with limit switches of the weight type, operating through a contactor. It is arranged to open the hoist-motor circuit at the upper limit of travel of the load block. When the load block has a tendency to over drift, a momentary lowering circuit is established.

The motor, controller, gearing and mechanical brake, electric brake, limit switch and winding mechanism are each independent of one another. Any of the units enumerated is separately accessible and may be completely disassembled without disturbing any other unit.

Respirator for Spray Painters

The Binks Manufacturing Company, Chicago, announces the addition of a lightweight respirator to its line of spray equipment and accessories. Known as

Binks lightweight respirator

Binks No. 10 pad-type respirator, it consists of a flexible aluminum frame which holds a specially treated replaceable pad over the operator's nose and mouth, conforming to the contour of the face. The respirator permits full vision and unhampered working freedom.

One-Piece Welding Helmet

A welding helmet, formed of one-piece black vulcanized fiber and cut deeply to offer side protection to a point well back of the ears, has been added to the line of protective devices for head, eyes, nose, throat and lungs manufactured by Willson Products, Inc., Reading, Pa. The usual riveted, lapped-over seams or joints are eliminated in the design of this helmet. A

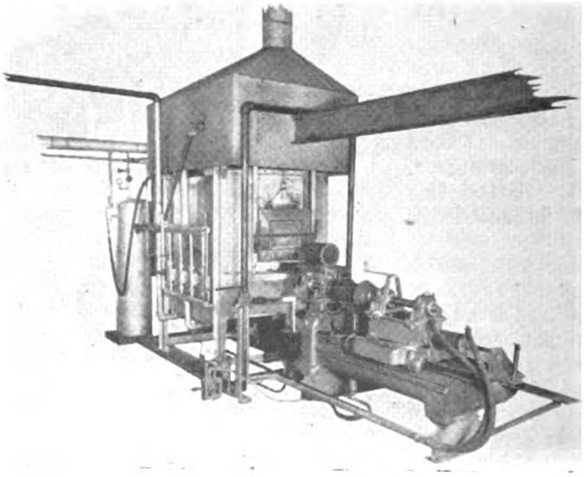
Willson welding helmet fabricated in one piece

smooth, rounded interior promotes air circulation and results in a well ventilated, cool, comfortable helmet. The Willson Company is making several different styles of helmets and hand shields in one-piece construction.

Centrifugal Casting Of Xaloy

A method of centrifugal casting perfected by the Wilcox-Rich Division of the Eaton Manufacturing Company, Detroit, Mich., under license from the Industrial Research Laboratories, Ltd., involves the application of Xaloy in a molten state to the outside or inside diameters of bushings or other tubular pieces subjected to abrasive wear. The coating of Xaloy has uniform surface hardness and uniform thickness. Due to the extreme hardness and abrasion resistance of this metal, the thickness of the wall is controlled very closely to reduce to a minimum the finishing operation for which special honing and grinding equipment is required. The resulting surface is mirror-like with a low coefficient of friction.

Application of the metal to irregular surfaces is accomplished by means of casting in permanent or sand moulds or by the use of inserts faced with Xaloy. Narrow flat surfaces or edges are coated with Xaloy by the centrifugal-casting method; however, sizes are at present somewhat restricted. Applications which seem apparent from the need for such a surface include drill and reamer bushings, deep drawing



Furnace for the centrifugal casting of Xaloy

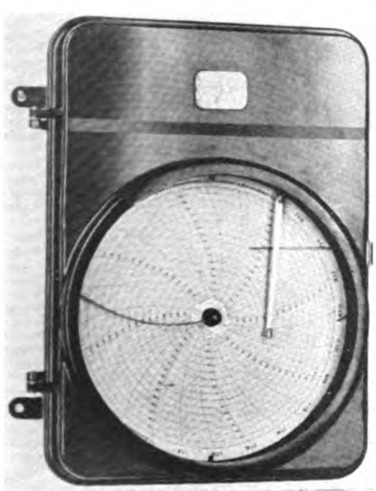
dies, sizing dies, briquetting moulds, work-rest blades, ring and plug gauges, packing gland sleeves, cylinders, pilot bars and valves. In ascertaining the usefulness of Xaloy in the general industrial field it was found, for instance, that the life of tool bushings is lengthened 500 to 600 per cent.

Xaloy is most suitable where its high hardness and unusual resistance to abrasion can be used to advantage and where high impact values and ductility are not important. It has a tensile strength of 43,000 lb. per sq. in. and compression strength of 240,000 lb. per sq. in. Its coefficient of thermal expansion is 0.0000072 in. per in. per deg. F. and its thermal conductivity is 7.5 B.t.u.'s per hr. per sq. ft. per deg. F. Its hardness is equivalent to 750 Brinell or 68 to 70 Rockwell C scale.

Recording Pyrometer

A recording potentiometer pyrometer of the round-chart type, known as the "Pyromaster," has been developed by The Bristol Company, Waterbury, Conn. The instrument is also available as an electric-type controller, with metal-to-metal contacts. It operates on an entirely different principle, which makes possible the following features:

It requires no lubrication; it is not affected by normal plant vibration; there is no mechanical motion of any kind except when a change in the measured quantity takes place; and it can be used under exceedingly rough plant conditions where the air is laden with moisture, corrosive fumes or dust. The operating mechanism consists of five small compact units which are replaceable. There are no mechanical connections of any kind between the galvanometer unit and the other units. The pen is actuated in such a way as to follow changes in the measured quantity as they occur and at a rate dependent upon the rate of change. The entire mechanism is built in a standard Bristol's instrument case of moisture-, fume-, and dust-proof construction for wall or flush panel mounting.



Bristol recording potentiometer pyrometer

Carbon And Alloy Steel Wrenches

J. H. Williams & Company, 75 Spring Street, New York City, announce two lines of adjustable wrenches with square shoulders on the movable jaw shank to overcome the wedging and spreading action common to the conventional cylindrical bearing and to provide a positive bearing against working stress. This design permits a thicker and stronger web without increasing the total head thickness of the wrench. The two lines of wrenches are called "Adjustable" and "Superjustable," respectively.

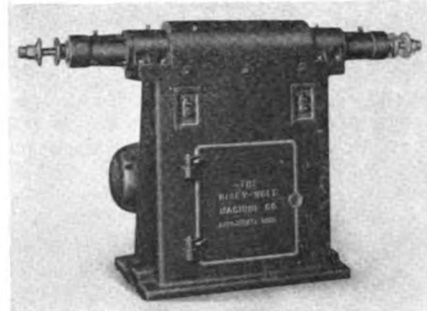
Williams "Adjustable" wrench with square shoulders on movable jaw shank

The "Adjustable" wrenches are drop-forged from carbon steel. This line is supplied in a natural polished steel finish. The "Superjustable" wrenches are forged from chrome-alloy steel, designed for lightness and strength. This line is finished in chrome-plate with highly polished heads and satin-finish handles. Both lines are available in sizes of 4, 6, 8, 10 and 12 in.

Texdrive Buffing and Polishing Machines

Texdrive buffing and polishing machines with externally mounted motors of any size or type desired and ranging in size from 3 hp. to 25 hp. have recently been placed on the market by the Hisey-Wolf Machine Company, Cincinnati, Ohio. The motor is mounted externally behind the unit and V-belt connected to the spindle, thereby eliminating the motor housing from the top of the pedestal and providing any and all speeds for any size or kind of buffing and polishing wheel, regardless of the electric current available.

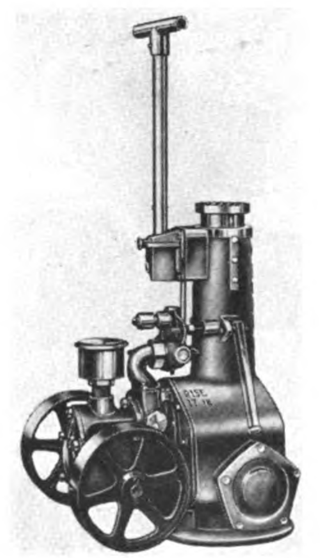
The spindles of the machine are of one-piece construction and are made of heat-treated spindle steel. All the bearings are oversize ball bearings mounted close to the wheels. Each inner race is locked individually on the shaft without the use of sleeves or bushings, and have labyrinth seals to exclude dust and grit. Each bearing is individually lubricated, being equipped with a filler, an oil lever and a drain. The bearing housings have a full-length keyway on top of the column to assure permanent alignment. The spindles and bearing housings are removable as an integral unit without disturbing the bearings. The machines are made with either one or two spindles and with single- or double-motor drive, respectively.



The Hisey-Wolf two-motor two-spindle buffing and polishing machine with motor mounted externally

Rotary-Motor Power Jack

The Duff-Norton Manufacturing Company, Pittsburgh, Pa., has developed a power jack equipped with a rotary-type motor for use in car and locomotive repairing which operates with greatly increased speed on the average air pressure maintained in railway shops. Tests by the manufacturer indicate that the load can be raised 25 to 50 per cent faster than with former types of jacks. The same shop tests also indicate that the jacks consume no more air per unit of work done than ordinarily required despite its increased lifting speed. The rotary motor now makes it possible to regulate these jacks by means of an adjusting screw when operating them



Duff-Norton power jack equipped with rotary-type air motor

in pairs, thus assuring one-man control of the heaviest loads.

These jacks are built in capacities of 50, 75 and 100 tons with raises of 14, 17, 25 and 30 in., and are equipped with large wide-treaded wheels and a folding handle built integrally with the jack, making for easy portability over rough shop surfaces or soft ground.

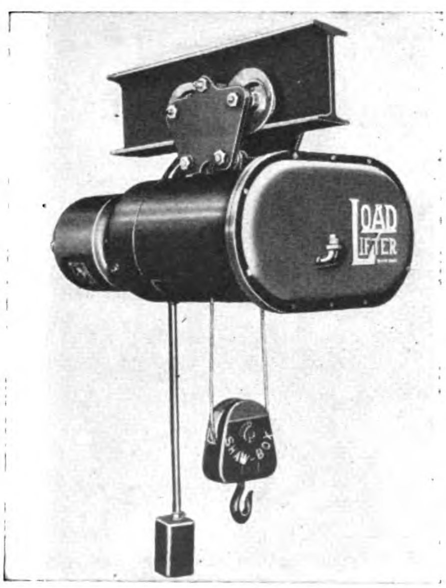
Construction features include ball-bearing thrust and radial mountings throughout, an automatic shut-off which cuts the motor off when the lifting standard reaches the safe limit or its lift or depth, and an up-and-down throttle control assuring finger-tip control under all loads.

In addition to this power jack equipped with a rotary motor, Duff-Norton will also continue to manufacture jacks operated by piston-type air motors.

Electric Hoists For Low-Head Room

Two small low-head-room electric hoists built in sizes to lift 350 and 700 lb. have just been placed on the market by Shaw-Box Crane & Hoist Company, Inc., Muskegon, Mich., under the trade name "Load Lifter Junior." They are replicas of the larger capacity low-head-room electric hoists manufactured by this firm. With them the distance from the bottom of the track on which the hoists operate to the hook when in its highest position is less than that of a chain hoist suspended from a trolley, it being only 12¾ in.

These small hoists have a lifting speed of 20 ft. per min. with rated capacity loads, and give a hook lift of 18 ft. Control is by push buttons contained in a unit suspended from the hoists. The hoists are comparatively light in weight, weighing only 185 lb. ready to operate, complete with trolley.



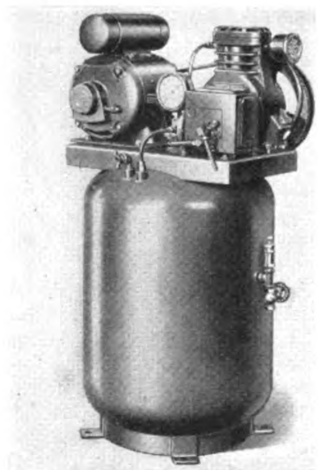
The Shaw-Box small electric hoist for low-head-room locations

The gear train of the hoists consists of only two gears and pinions. Ball bearings are employed at every bearing. The motor is of the totally enclosed ball-bearing type. The hoists are equipped with two brakes, an electrically operated motor brake and an automatic mechanical load brake of the roller ratchet type that controls the load during lowering so that the lowering speed is approximately the same as the hoisting speed. The hoist is totally enclosed, all parts being built into the hoist frame. The gearing and mechanical load brake operate in an oil bath.

Fractional-Horsepower Air Compressors

The Ingersoll-Rand Company, Phillipsburg, N. J., has developed a line of fractional-horsepower air compressors made in ¼-hp. and ½-hp. sizes. They have automatic start-and-stop control and are equipped with a seamless steel tank and an improved check valve.

When furnished for single-phase current they are equipped with a brushless capacitor-type motor and a built-in automatic protection switch, giving overload and under-voltage protection. They are rated for 150 lb. per sq. in. maximum pressure, but may be set for lower pressures, or may be equipped with a reducing valve for still lower pressures.

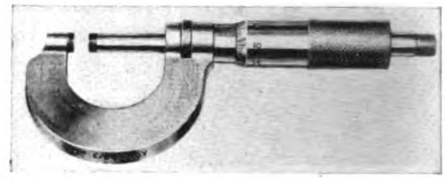


Ingersoll-Rand ¼-hp. single-stage air compressor

The ¼-hp. and ½-hp. units, available on a 2.4 cu. ft. tank as illustrated, are less than 35 in. high. The ½-hp. size is also available on a 4.6-cu. ft. tank in either vertical or horizontal mounting. If desired, the units can be furnished without the tank.

Carboloy Tips For Micrometers

The Carboloy Company, Inc., Detroit, Mich., manufacturers of cemented carbides, announces a micrometer tipping service available to all micrometer users. By means of this service the micrometer user sends his micrometer to the Carboloy Company, who tips with Carboloy cemented carbides the wear points at the ends of the anvil and spindle. The micrometer is then accurately adjusted and returned to the owner, ready for immediate use. It is reported that the micrometers will hold to a closer degree of accuracy during a period of use that averages at least 50 times longer life than micrometers without Carboloy tips.



Micrometer with anvil and spindle tipped with Carboloy

Light-Weight High-Cycle Reamers

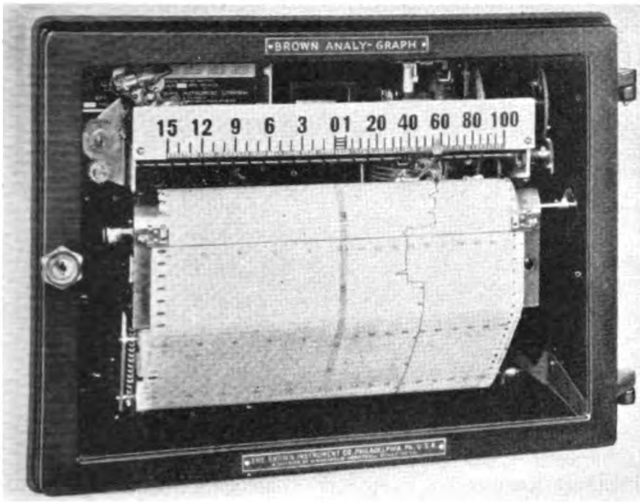
The Black & Decker Manufacturing Company, Towson, Md., has recently designed two high-cycle reaming motors of the flat type for ready accessibility in narrow clearances. The units designated as the Black & Decker-Van Dorn No. 225 and No. 350 high-cycle reamers are more powerful per pound weight than former models, being made of heat-treated aluminum castings. A safety switch control is designed to cut off instantly when the operator's grasp on the handle is released. The reamers are designed for heavy-duty drilling and reaming in fabricating plants, railway repair shops, structural-steel and bridge shops. They are specially adapted to reaming rivet and stay-bolt holes.

Light-weight Black & Decker-Van Dorn reaming motor, adapted to reaming rivet and stay-bolt holes

Measuring Quality of Furnace Atmosphere

The Brown Instrument Company has brought out a furnace atmosphere "Analy-Graph" which has been produced after elaborate testing to determine the most important measurable factors in furnace atmospheres. The tests covered both electric and fuel-fired furnaces, two widely differing sources of gas feed, and a wide range of temperatures with varying adjustments of air-gas ratios.

The recording instrument is of the potentiometer type and is equipped with a chart 12-in. wide graduated so as to render the equipment applicable to measure atmosphere quality whether the atmosphere results from complete or incomplete



Left: The Brown "Analy-Graph" for analyzing gas atmospheres in heat-treating furnaces

combustion, or from dissociation. The equipment operates on the principle of measuring the thermal conductivity of the gas mixture which is continuously drawn from the furnace. If the gas is the result of complete combustion, the thermal conductivity will be less than 1.00 due to the presence of CO_2, while if the sample has been produced by incomplete combustion or by dissociation, the thermal conductivity will nearly always be greater than 1.00—the only exception being when there is less than one per cent combustible in the final mixture.

In order to render the instrument equally useful for measuring all types of atmospheres, the chart has been divided into two equal sections; one section is used when combustion is complete, while the other is used when combustion is incomplete. This is accomplished by using different electric sensitivities for the Wheatstone bridge through a patented feature.

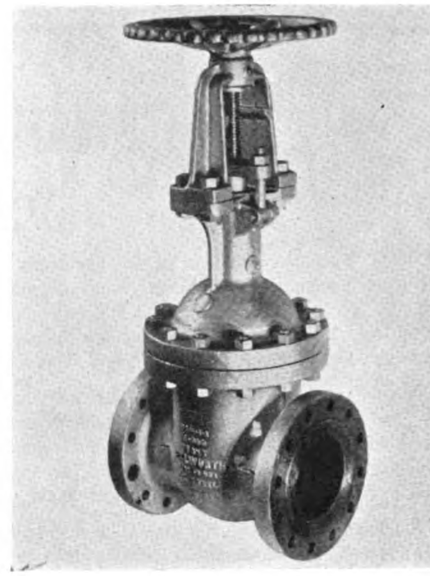
The Analy-Graph was designed for use in heat-treating where it is now generally recognized that for best results in preheating, hardening, and carburizing special gas atmospheres must be maintained around the metal. It does away with guess work in establishing the furnace atmosphere and applies potentiometer accuracy to the measurement of furnace-atmosphere quality. It is independent of normal variations in furnace pressure, room temperature, and atmosphere humidity. The large scale on the instrument permits operators to observe continually the condition of their furnace atmosphere even at a distance.

One-Piece Ratchet Threading Dies

Beaver Pipe Tools, Inc., Warren, Ohio, recently placed on the market the illustrated No. 6-R Beaverette ratchet die for threading ¼-in., ⅜-in., ½-in. and ¾-in. pipe without changing the dies or bushings. Two sets of dies are always in the tool, since this threading range covers two different thread pitches. The dies can be adjusted for cutting oversize or undersize threads on the pipe which is centered in the tool by a Universal pipe guide. The tool is so designed that close nipples can be threaded.

The Beaverette No. 6-R one-piece ratchet die

Heavy-Duty Steel Gate Valves

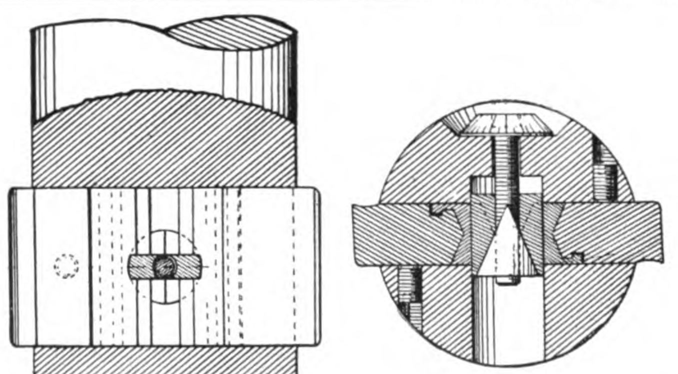


Heavy walls, deep stuffing boxes, and oversize stems are features of Walworth heavy-duty steel gate valves

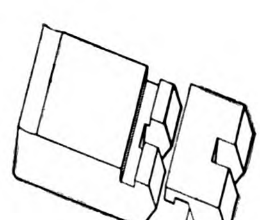
Heavy wall thicknesses, deep stuffing boxes, oversize stems, streamline flow and steel handwheels with fluted non-slip rims are some of the latest engineering features included in Walworth steel gate valves now available for 150 lb. and 300 lb. steam pressures. Made of carbon Molybdenum steel (identification symbol C-1) to A.S.T.M. specifications A-157-36, they meet the requirements of all applicable specifications. The illustration shows one of the 300-lb. valves. They are the products of the Walworth Company, New York, N. Y.

Adjustable Boring-Bar Cutters

The Apex Tool & Cutter Company, Inc., Shelton, Conn., have added another adjustable tool to its line of inserted tools by the adaption of a separate cleat which, when used with its boring-bar cutters, doubles the life of the cutter. The boring bar used for turning and finishing wheel centers is shown in the accompanying drawing with a pair of cutters inserted along with the cleats. The side view of the bar shows the added length of the cutter with the cleat in place. These cleats will give an overall extension of 1 in.



Apex adjustable boring-bar cutters



Stock cutters as shown in the drawing are made in all lengths for 4½-in. by 8-in. to 6½-in. by 12-in. wheels and ground both for roughing and finishing iron or steel. All cutters are forged of selected high-speed steel and uniformly heat-treated.

Among the Clubs and Associations

New York Railroad Club.—The annual golf tournament, field day and dinner of the New York Railroad Club will be held on Tuesday, June 8, at the Westchester Country Club, Rye, New York.

Eastern Car Foremans' Association.—The Eastern Car Foremans' Association will hold its annual field day and golf tournament on Thursday, July 15, at the Race Brook Country Club, New Haven.

Central Railway Club.—The Central Railway Club of Buffalo, N. Y., in conjunction with the Transportation Club of Buffalo, will enjoy its annual cruise, on Saturday, June 12.

Western Railway Club.—F. G. Gurley, assistant vice-president, Chicago, Burlington & Quincy, was elected president of the Western Railway Club at its annual dinner in Chicago on May 17. At the same meeting, M. B. McPartland, general superintendent of motive power, Chicago, Rock Island & Pacific, was elected first vice-president; E. A. Clifford, general purchasing agent, Chicago & North Western, was elected second vice-president; and C. L. Emerson, division master mechanic, Chicago, Milwaukee, St. Paul & Pacific, was re-elected executive secretary. J. W. Fogg, vice-president, MacLean-Fogg Lock Nut Company, was re-elected treasurer, and vacancies on the board of direction were filled by D. C. Curtis, retiring president; W. L. Fox, general superintendent, Chicago & Western Indiana; H. H. Urbach, mechanical assistant to executive vice-president, Chicago, Burlington & Quincy, and V. R. Hawthorne, secretary, Division IV, Mechanical, Association of American Railroads. At the same meeting, L. Robinson, assistant to general superintendent of motive power, Illinois Central, was re-appointed general chairman of arrangements. The meeting was addressed by Everett M. Dirksen, congressman from Illinois.

American Society of Mechanical Engineers.—The nominations for officers of the American Society of Mechanical Engineers for 1938 were announced by the Nominating Committee at Detroit, Mich., during the semi-annual meeting of the Society, May 17 to 21. Presented by the regular Nominating Committee are the following: For president, H. N. Davis, president, Stevens Institute of Technology, Hoboken, N. J. For vice-president, to serve one year: F. O. Hoagland, master mechanic, Pratt & Whitney Division, Niles Bement-Pond Co., Hartford, Conn. For vice-president, to serve two years: B. M. Brigman, Dean, Speed Scientific School, University of Louisville, Louisville, Kentucky; Hart Cooke, mechanical engineer, American Locomotive Company, Diesel engine Division, Auburn, N. Y.; W. H. McBryde, consulting engineer, San Francisco, Calif., and L. W. Wallace, director, Equipment Research, Association of American Railroads, Chicago. For managers, to serve three years: Carl Bausch, vice-president, Bausch & Lomb Optical Co., Rochester, N. Y.; S. B. Earle, Dean, School of Engineering, Clemson A. & M. College, Clemson College, S. C., and F. H. Prouty, Prouty Brothers Engineering Co., Denver, Colo.

Mechanical Division, A.A.R.—The sessions of the convention of the Mechanical Division, Association of American Railroads, June 16-23, inclusive, will be held in the Atlantic City Auditorium, beginning promptly at 9:30 a. m., Daylight Saving Time. Afternoons and Saturdays will be set aside for inspection of exhibits. The Committee on Subjects will be appointed by the Chairman at the opening session on Wednesday, June 16, to receive from members questions for discussion. This committee will determine whether such questions are suitable ones for discussion and, if so, will report them to the Division at an appropriate time for discussion by the members. The technical program is as follows:

Wednesday Morning, June 16

Address by J. M. Symes, vice-president, Operations and Maintenance Department, Association of American Railroads.
Address by Chairman—J. W. Burnett, general superintendent motive power and machinery, Union Pacific.
Action on Minutes of 1936 Annual Meeting.
Appointment of Committees on Subjects, Resolutions, Correspondence, etc.
Unfinished business.
New business.
Report of General Committee.
Report of Nominating Committee.
Discussion of Report on Lubrication of Locomotives.

Thursday Morning, June 17

"Research and Locomotive Development," by W. H. Winterrowd, vice-president, Franklin Railway Supply Company, Inc.
Discussion of Report on Locomotive Construction.

Friday Morning, June 18

Discussion of Reports on:
Electric Rolling Stock.
Specifications for Materials.
Joint Committee on Utilization of Locomotives and Conservation of Fuel.
Safety Appliances.
Air Conditioning and Equipment Lighting.

Monday Morning, June 21

Address: Hon. Frank McManamy, member, Interstate Commerce Commission.
Discussion of Report on Car Construction.

Tuesday Morning, June 22

"What Next in Car Equipment?" by L. K. Sillcox, first vice-president, New York Air Brake Company.
Discussion of Reports on:
Arbitration Committee.
Committee on Prices for Labor and Materials.
Committee on Loading Rules.
Committee on Tank Cars.
Committee on Lubrication of Cars.

Wednesday Morning, June 23

Discussion of Reports on:
Couplers and Draft Gears.
Brakes and Brake Equipment
Wheels.
Election of Members of General Committee.

Club Papers

Tank Car Design

Chicago Car Foremen's Association.—The regular monthly meeting of the Car Foremen's Association of Chicago held May 10 at the LaSalle hotel, Chicago, was addressed by R. W. Thompson, chief engineer, General American Transportation Corporation, on the general subject "Tank Cars—Their Design and Services." ¶ Mr. Thompson devoted the first part of his paper to a discussion of tank car specifications, truck design, underframe, bolster slabbing, anchorage, center of gravity and heater pipes. He discussed the A.A.R. tank car classification also the I.C.C. specifications for shipping containers for various commodities, tank linings of various types and special cars for the transportation of such materials as ethyl fluid, caustic soda, sulphuric acid, beer, etc. ¶ In preparing this paper Mr. Thompson said "it has been my desire first to give an early history of the tank car and to show how advancement has been made in its specifications, later to show how by years of operation improvements have been made in its construction, how its parts have been perfected to enable the car to remain in continuous operation and, finally, how the development of new tank cars for special services has contributed in bringing new and additional business to the railroads."

A.S.M.E. Meets at Detroit

American Society of Mechanical Engineers.—The 1937 semi-annual meeting of the American Society of Mechanical Engineers, held May 17-21, inclusive, at Detroit, Mich., proved of sufficient general interest to attract a registered attendance of 940 members and guests, including a considerable number of representative men in the railway and railway supply fields. The five-day meeting was notable for the inclusion of addresses and papers on eight definite railroad subjects and, in addition, several other papers presented information having an important bearing on present and future railroad problems. ¶ In the first general session, following a keynote address by C. F. Hirshfeld, chief on research, the Detroit Edison Company, on the influence of automotive production methods in other engineering fields, the subject "Modern Locomotive and Axle Testing Equipment," was discussed in a paper by T. V. Buckwalter, vice-president; W. C. Sanders, general manager, Timken Railroad Division, and O. J. Horger, research engineer of the Timken Roller Bearing Company, Canton, Ohio. In presenting this paper, Mr. Buckwalter showed how improved locomotive driving and running gear reduces dynamic augment on the

(*Continued on next left-hand page*)

rail and vibration in locomotive and track structures, thus permitting much higher operating speeds with safety. Preliminary results of fatigue tests on full size driver-axle assemblies were described, as well as the influence of designs, steels, and heat treatment upon axle fatigue strength. ¶ In discussing "Automotive Engineering Applied to Railroading," Edward G. Budd, president, Edward G. Budd Manufacturing Company, Philadelphia, Pa., pointed out the differences between automobile and railroad requirements and discussed automobile and airplane design upon the design and construction of railway equipment. Topics covered included the cost per passenger mile, weight reduction, ease of assembly and interchangeability, noise elimination and more rapid acceleration and braking. At this same session the "Economics of Power for Light-Weight Trains" was presented in a paper by Rupen Eksergian, Edward G. Budd Manufacturing Company, Philadelphia. In this paper the desirability of minimum weight equipment and limited weight power plants was stressed. This paper was replete with technical formulae and quantitative discussions in graph form, which provide a basis for determining the conditions best adapted for the various forms of motive power. ¶ At a joint meeting of the American Welding Society and the Machine Shop Practice division, the subject "Welded Steel in High-Speed Railroad Service," was presented by Everett Chapman, president, Lukenweld, Inc., Coatesville, Pa. Mr. Chapman described the basic design factors in welded steel construction and the detailed stresses which must receive attention if welded structures are to give long service under dynamic loads. In this paper and particularly the discussion which followed, the point was made that in spite of the tremendous advance and improvement in welding technic in recent years, welding is by no means a panacea, and this new fabrication process must be employed intelligently and particularly with reference to the elimination of internal stresses due to expansion and contraction, or the holding of these stresses within safe limits. ¶ The subject "High-Speed Diesel-Engine Maintenance Practice on the Canadian National," was presented by I. I. Sylvester, special engineer, Canadian National, Montreal. Mr. Sylvester described the experience of the Canadian National in maintaining Diesel engine driven equipment since 1925, with particular reference to the adaptation of steam locomotive maintenance organizations and methods to this newer type of power. He stressed the importance of performance and wear measurement records without which maintenance work is bound to be more or less haphazard, inefficient and unsatisfactory. "Electricity in Transportation" was the subject of a paper and talking moving picture presented by H. L. Andrews, vice-president, General Electric Company, New York, which showed in a striking way the different types of motive power applications which railroads are using today to help solve the problem of balancing income against expenditure. ¶ In discussing "Air Resistance of Railway Equipment," A. I. Lipetz, chief consulting research engineer, American Locomotive Company, Schenectady, N. Y., described wind tunnel tests on models of locomotives, streamline cars, and power cars for Diesel electric trains, which show that air resistance is the most important factor in air resistance of railway equipment operating in still air. For all practical purposes this resistance can be represented by a simple expression involving the square of the speed and a coefficient, which depends upon the shape and construction of the vehicles. In discussing the subject "Resistance of Light-Weight Passenger Trains," A. L. Totten, transportation engineering department, General Electric Company, Erie, Pa., described how the tracks, journals, wheel flanges, air, wind, air conditioning and lighting equipment affects the resistance of modern streamline trains. Formulae were included in the paper for calculating these specific resistances and examples were given showing their application. ¶ These eight specific railroad papers mentioned were presented at four meetings held under the auspices of the Railroad Division, two of the meetings being presided over by W. H. Winterrowd, vice-president, Franklin Railway Supply Company, Chicago, and two by W. E. Dunham, superintendent car department, Chicago & North Western, Chicago. E. L. Woodward, western editor *Railway Mechanical Engineer,* served as official recorder. In addition to the papers on specific railroad subjects, the discussion "Rubber Cushioning Devices" by Dr. Hirshfeld, was of considerable general interest to railway men and the same statement may be made with regard to several papers on Lubrication, Cutting Metals, Apprenticeship and Craftsmen Training.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

Air-Brake Association.—T. L. Burton, care of Westinghouse Air Brake Company, 3400 Empire State Building, New York.

Allied Railway Supply Association.—F. W. Venton, Crane Company, Chicago.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet avenue, Chicago.

American Society of Mechanical Engineers.—C. E. Davies, 29 West Thirty-ninth street, New York.

Railroad Division.—Marion B. Richardson, 21 Hazel avenue, Livingston, N. J.

Machine Shop Practice Division.—J. R. Weaver, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Materials Handling Division. — F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

Oil and Gas Power Division. — M. J. Reed, 2 West Forty-fifth street, New York.

Fuels Division.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

Association of American Railroads. — J. M. Symes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

Division I. — Operating. — Safety Section.—J. C. Caviston, 30 Vesey street, New York.

Division V.—Mechanical.—V. R. Hawthorne, 59 East Van Buren street, Chicago. 1937 convention, June 16-23, Atlantic City, N. J.

Committee on Research. — E. B. Hall, chairman, care of Chicago & North Western, Chicago.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey street, New York. Annual meeting, June 21, 22 and 23, Atlantic City, N. J.

Division VIII.—Motor Transport.—Car Service Division. — George M. Campbell, Transportation Building, Washington, D. C.

Association of Railway Electrical Engineers. —Jos. A. Andreucetti, C. & N. W., 1519 Daily News Building, 400 West Madison street, Chicago, Ill.

Canadian Railway Club.—C. R. Crook, 2271 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month, except in June, July and August, at Windsor Hotel, Montreal, Que.

Car Department Officers' Association.—A. S. Sternberg, master car builder, Belt Railway of Chicago, 7926 South Morgan street, Chicago.

Car Foremen's Association of Chicago.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

Car Foremen's Association of Omaha, Council Bluffs and South Omaha Interchange.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month at 1:15 p. m.

Central Railway Club of Buffalo.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

Eastern Car Foremen's Association. — E. L. Brown, care of the Baltimore & Ohio, St. George, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

Indianapolis Car Inspection Association.—R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

International Railway Fuel Association.—See Railway Fuel and Traveling Engineers' Association.

International Railway General Foremen's Association.—William Hall, 1061 West Wabasha street, Winona, Minn. Next meeting, September 28 and 29, Hotel Sherman, Chicago, Ill.

International Railway Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

Master Boiler Makers' Association. — A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y. Annual meeting, September 29 and 30, Hotel Sherman, Chicago.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September, at Hotel Touraine, Boston.

New York Railroad Club.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July, August and September, at 29 West Thirty-ninth street, New York.

Northwest Car Men's Association. — E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, University and Prior avenue, St. Paul.

Pacific Railway Club.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Calif., alternately—June in Los Angeles and October in Sacramento.

Railway Club of Greenville. — J. Howard Waite, 43 Chambers avenue, Greenville, Pa. Regular meetings, third Thursday in month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

Railway Fire Protection Association.—P. A. Bissell, 40 Broad street, Boston, Mass. Annual meeting, October 19-20, 1937.

Railway Fuel and Traveling Engineers' Association.—T. Duff Smith, 1255 Old Colony building, Chicago. Annual meeting, with exhibits, Hotel Sherman, Chicago, September 28, 29, 30.

Railway Supply Manufacturers' Association. —J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, Association of American Railroads. Exhibit June 16 to 23, inclusive, Atlantic City, N. J.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November. Ansley Hotel, Atlanta, Ga.

Toronto Railway Club.—R. H. Burgess, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

Traveling Engineers' Association.—See Railway Fuel and Traveling Engineers' Association.

Western Railway Club.—C. L. Emerson, executive secretary, 822 Straus Building, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.

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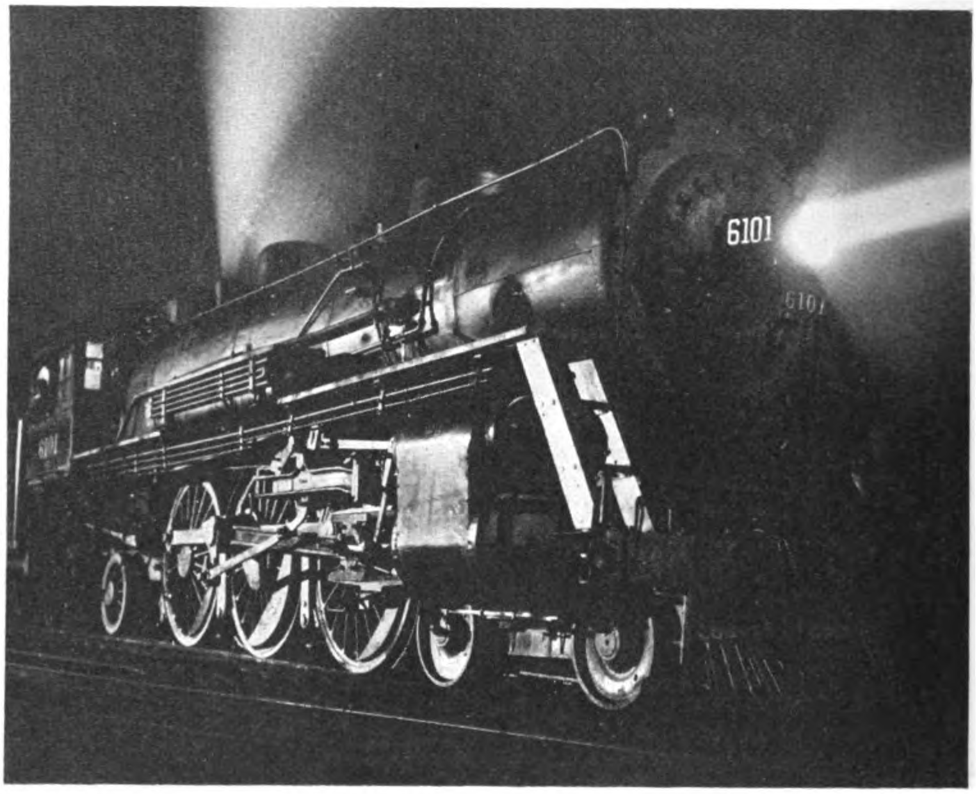

NEWS

N. Y. C. Rebuilding Passenger Cars

THE New York Central has placed in service on its Empire State Express two deluxe air-conditioned coaches, the first of 50 which it is rebuilding in its shops at Beech Grove, Indianapolis, Ind. The remaining 48 will be put in service, as rapidly as completed, on the company's principal trains between New York, Chicago, Cleveland, Ohio, Detroit, Mich., and St. Louis, Mo. For the Boston & Albany, 17 coaches are being air conditioned at Allston, Mass., and 8 additional coaches for the Pittsburgh & Lake Erie at the Beech Grove shops.

New Headlight on "400"

A NEW type headlight, which casts a gyrating beam of light in the shape of a figure eight, is being given its initial tests on the "400" of the Chicago & North Western, operating between Chicago and the Twin Cities. The new light, known as the Mars light, is of 3,000,000 candle power, and its reflector is oscillated by a motor which causes the beam to swing in arcs similar to a figure eight. The field of gyration of this figure eight is about 800 ft. in diameter at a distance of 1,000 ft., and precedes the locomotive a distance of 1,400 to 2,000 ft. The light is canary yellow in color and in yard tests it has been observed at a distance of three miles. The light itself is located on the top of the smokebox directly in front of the stack, which places it directly above the regular headlight. The light is expected to be of value as a warning signal when a train approaches crossings.

Eksergian Awarded 1937 Henderson Medal by Franklin Institute

Dr. Rupen Eksergian of the Edward G. Budd Manufacturing Company, Philadelphia, Pa., was awarded the 1937 George R. Henderson Medal of the Franklin Institute at the Medal Day Exercises of the Institute at Philadelphia on Wednesday, May 19. The Henderson medal, founded in 1924, is awarded for meritorious inventions or discoveries in the field of railway engineering. Dr. Eksergian was chosen as its recipient "In consideration of his contributions to railway engineering and his accomplishments in the field of railway locomotive and car design."

Lightweight Train and Locomotives for L., M. & S.

THE London, Midland & Scottish of Great Britain has completed the first of eleven lightweight trains, designed for long-distance excursion traffic, in which the use of high tensile steel and welding enables a reduction of 55 tons in weight compared with a 10-coach train of standard equipment, or 1.16 hundredweight less per passenger. Each 10-coach train comprises five two-coach units, and, by such articulation, there is a saving of 20 wheels per train.

The L., M. & S. has also placed orders for the construction of 85 new steam locomotives, according to the New York office of the Associated British and Irish Railways. Apart from five 4-6-2 engines to be built for the new high-speed express service between London and Glasgow, the new locomotives will comprise 15 standard six-coupled freight engines, 0-6-0 type, and 65 standard passenger tank engines, of a 2-6-2 wheel arrangement, for suburban service.

C. & E. I. to Use Lightweight Rail Cars

Two new streamline air-conditioned rail motor coaches, which will give short-run passengers the same modern service as that enjoyed by the passengers on long runs, will be placed in service by the Chicago & Eastern Illinois between Danville, Ill., and Cypress this month to supplement steam locomotive trains. On the 242-mile run between these points, each car will make one run a day under the present schedule. The cars, measuring 74½ ft., were constructed by the American Car & Foundry Company, and are equipped with Hall-Scott 200 hp. horizontal six-cylinder engines. Rapid acceleration and retardation of speeds feature the new cars.

Streamline Trains Between Bakersfield and Oakland

THE Atchison, Topeka & Santa Fe has asked the Railroad Commission of California for permission to improve its passenger service between Bakersfield, Cal.,

(Continued on next left-hand page)

and Oakland with streamline trains and by co-ordinating its trains and busses. The railroad proposes to establish coordinated and integral one-ticket rail and bus service and to install two all-steel, streamlined, 1800 hp. Diesel-electric, five-car trains which it will operate on two six-hour schedules, each way, a day. Specifications for these trains have been completed by the Santa Fe and the Edward G. Budd Manufacturing Company.

Equipment Depreciation Orders

THE Interstate Commerce Commission in a series of sub-orders in No. 15100, Depreciation Charges of Steam Railroad Companies, has prescribed depreciation rates applicable to the equipment of six roads. They are the Atlantic & Yadkin; the Indianapolis Union; the New York, New Haven & Hartford; the Pittsburgh, Lisbon & Western; the Rahway Valley; and the Wrightsville & Tennille.

The composite percentages, which are not prescribed rates but merely the averages of percentages applied to the individual primary accounts, range from 3.13 per cent for the Wrightsville & Tennille to 10.38 per cent for the Atlantic & Yadkin. The composite figure for the New Haven is 3.25 per cent, derived from individual rates prescribed as follows: Steam locomotives, 2.91 per cent; other locomotives, 3.1 per cent; freight-train cars, 4.1 per cent; passenger-train cars, 2.72 per cent; floating equipment, 2.57 per cent; work equipment, 4.38 per cent; miscellaneous equipment, 15.46 per cent.

Metal Statistics—A Correction

THE thirtieth (not the thirteenth) annual edition of Metal Statistics is reviewed on page 220 of the May issue.

New Equipment Orders and Inquiries Announced Since the Closing of the May Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Alton & Southern	1[1]	2-8-2	American Loco. Co.
Patapsco & Back Rivers	3[2]	600-hp. Diesel-elec.	Electro-Motive Corp.
	1[2]	600-hp. Diesel-elec.	American Loco. Co.
Philadelphia, Bethlehem & New England	1[2]	900-hp. Diesel-elec.	Electro-Motive Corp.
	3[2]	600-hp. Diesel-elec.	Electro-Motive Corp.
	1[2]	900-hp. Diesel-elec.	American Loco. Co.
Seaboard Air Line	5	Loco. tenders	Baldwin Loco. Wks.
South Buffalo	2[2]	600-hp. Diesel-elec.	Electro-Motive Corp.
	1[2]	600-hp. Diesel-elec.	American Loco. Co.
Steelton & Highspire	1[3]	600-hp. Diesel-elec.	American Loco. Co.
Wheeling & Lake Erie	10	6-wheel switch	Company shops

LOCOMOTIVE INQUIRIES

Road	No. of locos.	Type of loco.	Builder
Litchfield & Madison	1	0-8-0	....
	1	2-8-2	....

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Delaware & Hudson	100	40-ton box	Company shops
National Tube Co.	103	Bodies for 70-ton gondola	Ralston Steel Car Co.
Reading	300	50-ton single-door box	[4] Company shops
	250	50-ton double-door box	[4] Company shops
	50	50-ton box, with end doors	[4] Company shops
	50	All-steel flat	[4] Company shops
Union Pacific	1,900	50-ton box	[5] Company shops
	700	50-ton auto-box	[5] Company shops
	1,000	50-ton Ballast, Hart Selective	American Car & Fdry. Co.
	200	Tank	Gen. Amer. Trans. Corp.

FREIGHT-CAR INQUIRIES

Road	No. of cars	Type of car	Builder
Aliquippa & Southern	20	100-ton rack	....
American R. R. of Porto Rico	40	5,000-gal. tank	....
Cabot, Godfrey L., Inc.	20	35-ton steel covered hopper	....

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
Ft. W. & D. C.	4	Pass.	Edward G. Budd Mfg. Co.

PASSENGER-CAR INQUIRIES

Road	No. of cars	Type of car	Builder
C. R. I. & P.	10	de luxe lightweight steel coaches	....
G. M. & N.	2	Lightweight Cor-Ten steel sleeper-coaches	....
Norfolk Southern	1	Rail motor office	....

[1] To have 25 in. by 30-in. cylinders and a total weight in working order of 280,000 lb.
[2] Part of this equipment, which has already been delivered to the railroad, was ordered in the last quarter of 1936.
[3] Locomotive received by Steelton & Highspire.
[4] Inquiry is being made for underframes for these cars. In addition 50 hopper cars are to be converted into 50-ton cement hopper cars.
[5] The Ryan Car Company has received an order for 2,600 lightweight welded underframes for these cars.

Supply Trade Notes

THE EX-CELL-O AIRCRAFT & TOOL CORPORATION, Detroit, Mich., is now the Ex-Cell-O Corporation.

STANLEY T. SCOFIELD has been appointed assistant to vice-president of the United States Steel Corporation, New York.

JOSEPH T. RYERSON & SON, INC., has moved its downtown, Chicago, office from the Continental Illinois Bank building to the First National Bank building.

CLYDE GRIGSBY has been appointed western manager Railroad Division of the Socony-Vacuum Oil Company, Inc. Mr. Grigsby will have his headquarters at Chicago.

THE AMERICAN BRAKE SHOE & FOUNDRY CO., OF CALIFORNIA, has established its general offices at 1010 Russ building, San Francisco, Cal. A. L. Clark is president of this subsidiary company. The parent company is the American Brake Shoe & Foundry Co.

GEORGE MCM. GODLEY, who was president of the Burden Iron Company, Inc., Troy, N. Y., during 1935 and 1936, has been elected to fill the unexpired term of President Alfred Musso, who has resigned; Arthur S. Swan, vice-president, and Frank Hodson, assistant to the president, also resigned. O. A. Van Denburgh, Jr., a former manager of the company, has been placed in charge of operations.

RAYMOND C. BULLARD has been elected to the board of directors of The Bullard Company, Bridgeport, Conn., and will continue to serve as advertising and publicity manager of this company. Mr. Bullard, after graduating from college, spent six years as an engineering student in the various departments of The Bullard Company's manufacturing division. This was followed by a considerable period in the sales, engineering and advertising departments. For the last five years he has been advertising and publicity manager.

Raymond C. Bullard

P. A. MCGEE, assistant electrical engineer of the Reading-Jersey Central has resigned to join the sales department of the Electro-Motive Corporation. Mr. McGee will have his headquarters in the company's New York office at 230 Park avenue.

S. J. HALL, eastern manager of the Peerless Equipment Company, at New York, has resigned to serve as consulting engineer in the electrical field, specializing on design and installation of storage batteries, with headquarters at Chicago.

R. A. CARR, managing director of the Buenos Aires branch handling the South American business of the Dearborn Chemi-

(*Continued on next left-hand page*)

cal Company, has been elected vice-president with headquarters in Chicago to succeed C. M. Hoffman, who is now located in Los Angeles, Cal., where he is engaging in special work for the Dearborn Chemical Company. Mr. Carr was born at Oak Park, Ill., and after graduating from the University of Chicago, in 1926, engaged in advertising work. Later, he entered the employ of the Locomotive Firebox Company, Chicago, and in 1927 was a member of the dynamometer car staff of the Southern Pacific at San Francisco, Cal. In 1928, he reëntered the employ of the Locomotive Firebox Company, engaging in sales and production work, which position he held until 1934, when he entered the employ of the Dearborn Chemical Company.

WALTER H. BASELT, assistant chief mechanical engineer of the American Steel Foundries, has been appointed chief mechanical engineer, with headquarters in Chicago, and has been succeeded by Robert B. Cottrell. Mr. Baselt, who received his technical education at Armour Institute in Chicago, joined the engineering force of the American Steel Foundries in 1916 and has been continuously employed with

(c) Moffett Studio

Walter H. Baselt

this company since that date, except for a period of service with the government. He became assistant chief mechanical engineer in 1929.

RICHARD M. RAMPORT has been appointed sales representative of the General American Transportation Corporation, with headquarters at Chicago, to assist in the sales of freight cars and special car equipment. O. J. Parks, manager of sales in the freight car department, has been appointed general superintendent of the tank car repair department, to succeed I. A. Eakins, retired.

Obituary

W. R. GELLATLY, president of the Superior Railway Products Corporation, Pittsburgh, Pa., died recently in Florida.

P. C. JACOBS, who served as president of the National Railway Appliances Association in 1919-20, died at Hollywood, Cal., on May 10. Mr. Jacobs retired about 10 years ago as a sales representative for the Johns-Manville Corporation at Chicago.

Personal Mention

General

FRANK ROSS, electrical engineer of the Terminal Railroad Association of St. Louis, has been promoted to superintendent of motive power and equipment, succeeding William Bawden who, at his own request, has been appointed mechanical consultant.

C. K. STEINS, whose appointment as assistant chief of motive power (locomotive) of the Pennsylvania was reported in the May, *Railway Mechanical Engineer*, was born at East Orange, N. J., on February 21, 1891. He entered the service

C. K. Steins

of the Pennsylvania on July 28, 1913, as special apprentice in the Altoona machine shop and on May 1, 1919, was transferred to the New York division as assistant master mechanic. On March 1, 1920, Mr. Steins was appointed assistant engineer motive power in New Jersey and on January 16, 1924, became assistant master mechanic of the Philadelphia division. He was appointed assistant engineer motive power, eastern region, on July 1, 1926, and on February 1, 1928, became master mechanic of the Indianapolis division. He was transferred to the Maryland division as master mechanic on October 1, 1929, serving in this capacity until his appointment as assistant chief of motive power under the chief of motive power at Philadelphia, Pa.

H. C. WRIGHT, assistant master mechanic of the Pittsburgh division of the Pennsylvania, has been appointed to the newly-created position of assistant engineer motive power of the Western region with headquarters at Chicago.

Master Mechanics and Road Foremen

W. O. TEUFEL, master mechanic of the Western Pennsylvania division of the Pennsylvania, has been transferred to the Columbus, Cincinnati and Toledo divisions with headquarters at Columbus, Ohio.

CHARLES ALEXANDER WILSON, who has been appointed master mechanic of the Pennsylvania at Williamsport, Pa., as noted in the May issue of the *Railway Mechanical Engineer*, was born on September 29,

C. A. Wilson

1885, at North East, Md. He attended Pereyville Public School; Jacob Tome Institute, Port Deposit, Md., and Drexel Institute. He became employed as a machinist apprentice in the Maryland division shops of the Pennsylvania at Wilmington, Del., on June 8, 1903. Upon the completion of his apprenticeship he served as a machinist until 1909; as gang foreman, electrical department, until 1911; as foreman, electrical department, until 1917; as electrical supervisor, W. J. & S. R. R., until 1918; as assistant master mechanic, W. J. & S. R. R., until 1923; and assistant master mechanic of the Trenton division of the Pennsylvania, until 1925. From 1925 to 1929, he was master mechanic of the Tyrone and Cresson division; from 1929 to 1933, master mechanic of the Atlantic division, and from 1933 to 1937, master mechanic of the Pennsylvania & Reading Seashore Line. He became master mechanic of the Central Pennsylvania division on April 16.

Shop and Enginehouse

H. J. CANTRELL, a machinist in the shops of the Chesapeake & Ohio at Huntington, W. Va., has been promoted to the position of assistant enginehouse foreman.

JAKE MILLER, a machinist in the shops of the Chesapeake & Ohio at Hinton, W. Va., has been promoted to the position of assistant night enginehouse foreman, succeeding A. R. Reed.

Purchasing and Stores

P. E. WELCH, general foreman at the general store of the Southern Pacific Lines in Texas and Louisiana at Houston, Tex., has been appointed assistant general storekeeper, with the same headquarters.

JOHN R. WATT, assistant purchasing agent of the Louisville & Nashville, has been advanced to general purchasing agent with headquarters as before at Louisville, Ky., to succeed Harry T. Shanks, who has retired because of ill health.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, Railway Master Mechanic, and Boiler Maker and Plate Fabricator. Name Registered, U. S. Patent Office

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RAILWAY
MECHANICAL ENGINEER

The new "Super Chief"

Lightweight Cars for the

Sante Fe "Super Chief"

Nine cars of stainless-steel construction, built by the Edward G. Budd Manufacturing Company, embody luxurious fittings and a unique scheme of decorative treatment

On May 18 completely new equipment was placed in service on the Super Chief of the Atchison, Topeka & Santa Fe. This train, which makes a round trip each week on a one-way schedule of 39¾ hours between Chicago and Los Angeles, Calif., now consists of nine lightweight cars, built of stainless steel by the Edward G. Budd Manufacturing Company. Since the cars were placed in service a new 3,600-hp. Diesel-electric locomotive has been delivered to the railroad by the Electro-Motive Corporation and this locomotive is now regularly assigned to the Super Chief.

Unlike the trains previously built by the Edward G. Budd Manufacturing Company, the Super Chief is made up of separate coaches, without articulation. The exterior, however, is completely sheathed with stainless steel in narrow, curved, longitudinally beaded panels below the windows, flat sheets between the windows and corrugated sheets above the windows and on the roof. The surface is not painted, except for the lettering on the letterboards and the name plates.

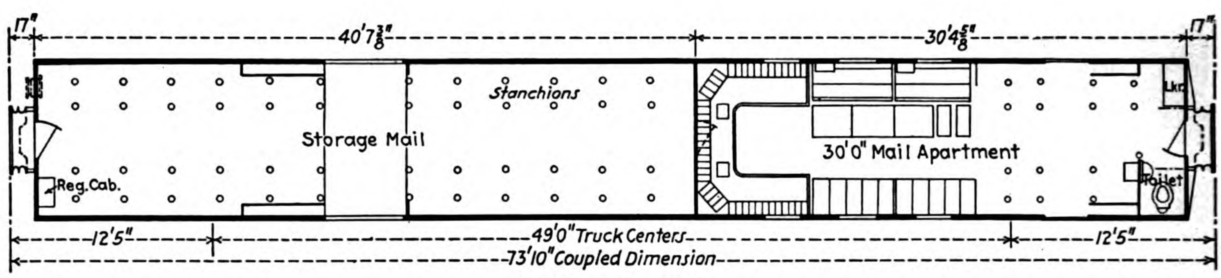
The cars are built without hoods, conforming in general external appearance to coach No. 3070 which this builder completed for the Santa Fe early in 1936, except that the apron below the sides of the cars has been removed opposite the trucks.

The consist of the train is shown in a table. The total weight of the train ready to run, exclusive of motive power, is 851,000 lb. There are berth accommodations for 104 passengers, with 42 seats in the observation lounge and cocktail lounge and seats for 36 in the dining car. Bunks in the crew quarters accommodate 12 persons.

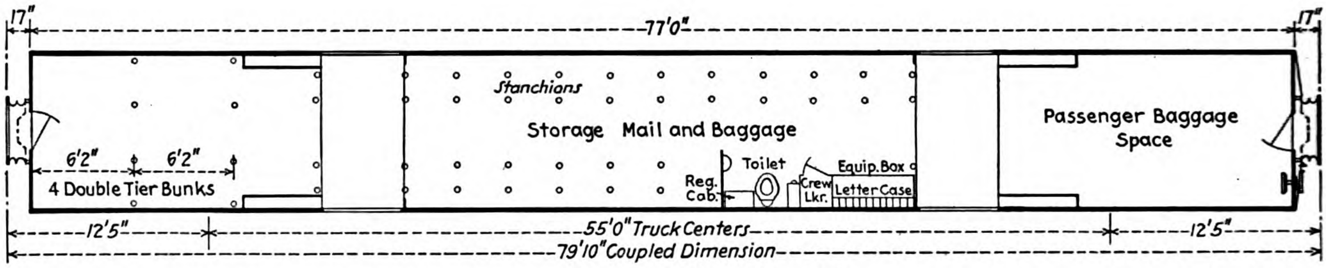
The Car Structures

The car structures are fabricated from the so-called 18-8 stainless steel by the Budd Shotweld process, except for the end, underframes and bolsters which are Cromansil fabricated by the Lukenweld process. Two types of stainless steel, based on physical properties, were used in building this train. The high-tensile material has a unit strength of 150,000 lb. per sq. in. and is generally employed in the strength members of the structure. The low-tensile material with a unit strength of 100,000 lb. per sq. in. is used where ductility or special finish is of paramount importance.

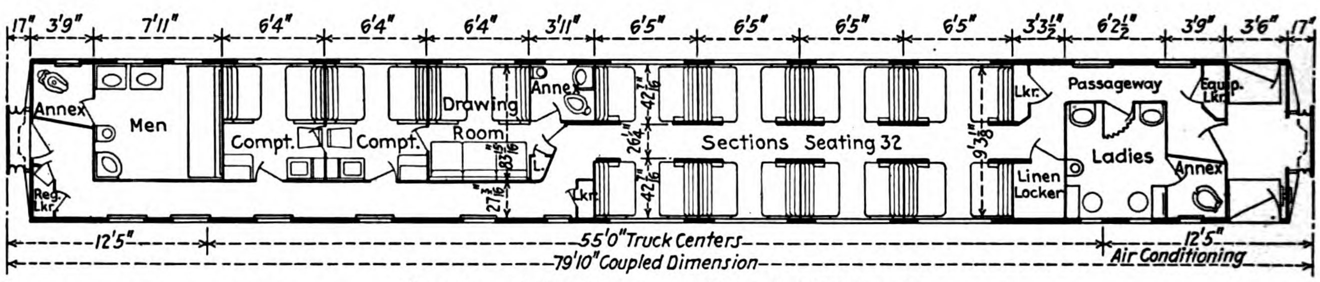
A number of changes have been made in details of the structure as compared with those employed in Santa Fe coach No. 3070. In that car a departure was made



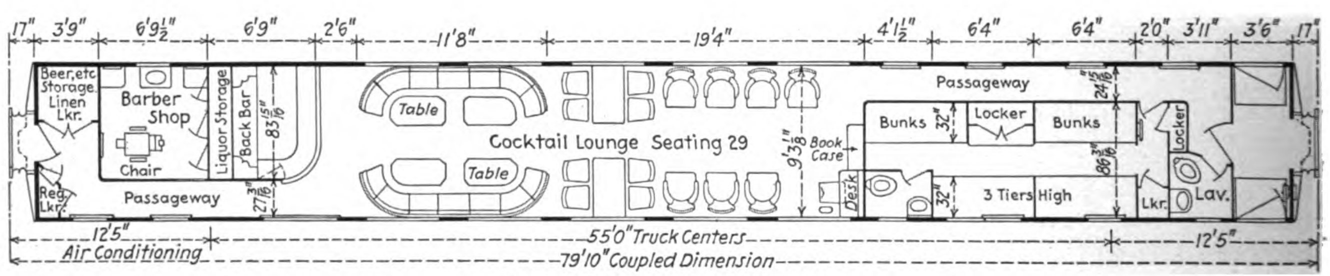
Postal car No. 3400



Storage-mail and baggage car No. 3430



Floor plan of the sleeping cars "Isleta" and "Laguna"

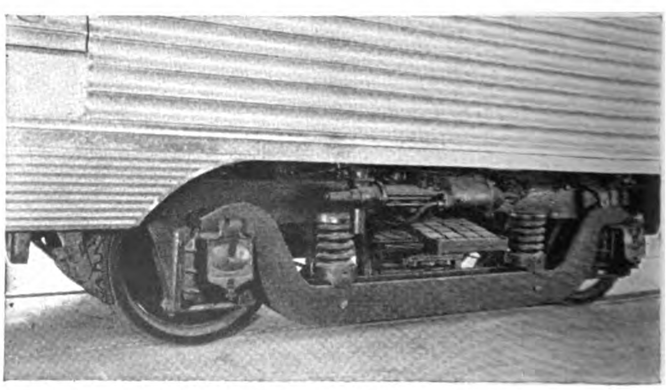


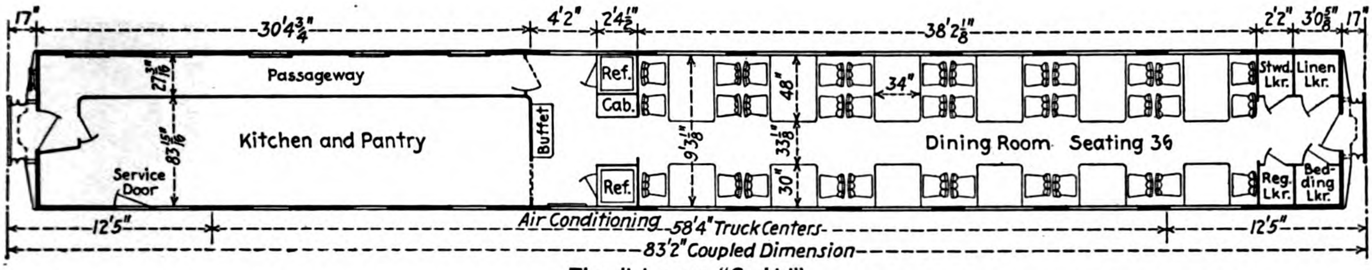
The cocktail lounge car "Acoma"

from the truss form of side-frame structure characteristic of all of the other trains built by this company. Wide vertical members of channel section were placed between the windows. In the cars of the Super Chief a return has been made to the modified Pratt truss type of structure, using narrower vertical channel members and diagonals in the panels between and below the windows.

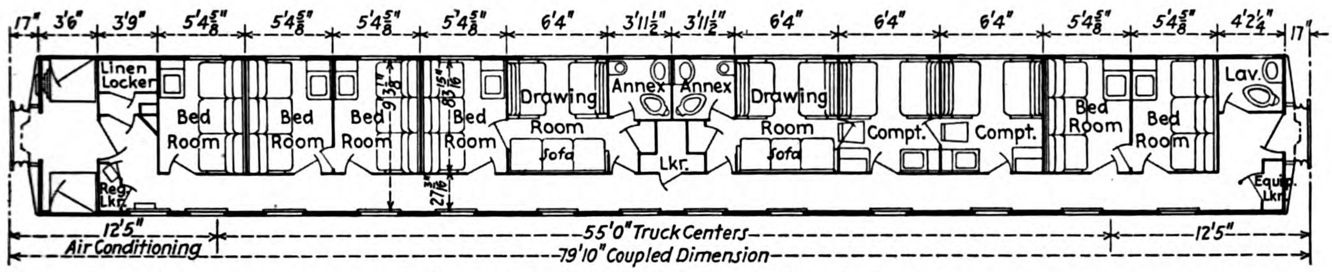
The underframe structure is essentially that employed in coach No. 3070, except that the channel-section floor stringers have been replaced by members of Z-section. This marks a further step in the progressive simplification of the Budd type of construction by which the number of pieces and amount of welding have been reduced.

With the exception of postal car No. 3400, the dining car "Cochiti," and the sleeper-observation car "Navajo," the car bodies are essentially of the same overall dimensions as the first coach No. 3070. They are 79 ft. 10 in. coupled length; 10 ft. 1/8 in. outside width, and 13 ft. 6 in. in height above the rail. Inside, the width is 9 ft. 3 1/4 in. The mail car is 73 ft. 10 in. in length; the dining car, 83 ft. 2 in. in length, and the sleeper-observation car, while not appreciably longer than the other sleeping

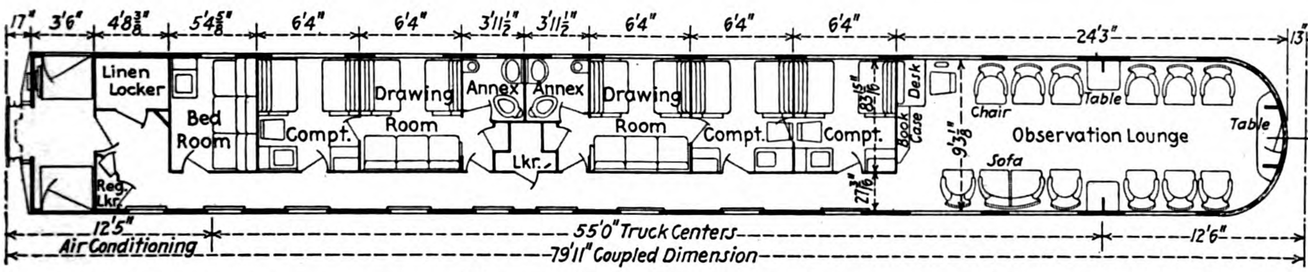

One of the double-equalizer trucks



The dining car "Cochiti"



Floor plan of the sleeping cars "Oraibi" and "Taos"



The compartment-observation car "Navajo"

Arrangement of the open sections in the "Isleta" and the "Laguna"

cars, is built with a curved rear end, over which the roof is hooded.

The center of the roofs is insulated with 2-in. Dry Zero. The roofs adjoining the side walls, the side walls and end walls are insulated with 3 in. of the same material. All of the hollow structural members are filled with Kimsul. The space between the tops of the cross-bearers and the under side of the corrugated floor sheets is filled with Hairfelt or Salamander. The floor consists of 1 in. of cork laid over the corrugated floor sheets, the recesses of which are filled with cork strips. Above the cork is a ¼-in. Super Pneu pad on which the carpet is laid.

The ceilings and side walls of the cars are generally finished with Masonite which, on the walls, forms the base for the Flexwood surface and, on the ceiling and parts of the walls, has a painted finish. The partition frames are of carbon-steel tubes of square cross-sectoin to which the Masonite is applied by Shakeproof self-tapping screws. The Masonite is insulated from the steel work by strips of gummed cork-felt tape.

The outside doors throughout this train are so constructed as to fit flush and present a continuation of the body surface when closed. The passenger doors are fitted with O. M. Edwards folding steps, which, when not in use, are folded up to close the step well with an outside surface similar to that of the body proper. The steps are faced with aluminum Diamondette treads with a nosing of punched and formed stainless steel as a guard against slipping.

The interior doors are hinged in such a manner that there is no possibility of pinching, without the use of anti-pinch plates.

Installing the channel floor sheets

The side frame is of truss form

The windows in the passenger occupancy sections of these cars are double glazed with the outside glass fixed in the car body and the inner glass mounted in a hinged frame. The inner glass can be unlocked and swung inward to permit cleaning. The glass in both frames (inner and outer) is set in rubber to eliminate the transfer of any strain to the glass. A rubber gasket seals the space between the inner and outer sash. A departure from standard practice is the arrangement of small windows in the letterboard area of the open sections for the use of the upper-berth occupants. These are of the same construction as the large windows with their fixed outer sash and hinged inner sash. Small windows in the aisles, in the kitchen, and in the rear of the last car are of the movable type and are provided for emergency ventilation and to facilitate terminal servicing. All plain glass is shatterproof, 1/4 in. thick.

An Innovation in Berth Construction

Each of the open sections in the first two sleeping cars embodies a maximum of privacy by being partially enclosed by a narrow longitudinal partition extending each way from the aisle side of the section partitions. Additional comfort is assured by making all of the berths 6 ft. 5 in. in length. Mishawaka rubber mattresses are used.

A further innovation in berth arrangement is the construction of the upper berth. Instead of swinging upward when in day position and forming a curved side ceiling, it is pushed up to a daytime position parallel to the night position, forming a flat ceiling over the section, the narrow opening between the car ceiling and the upper berth being enclosed by the upper berth curtain. The flat upper-berth tray is supported by rollers on four spindles projecting from the ends, one at each corner, into recessed guides in the partitions between the sections. From the day position the upper berth is lowered by first slightly lifting and moving the front of the berth toward the aisle when it will drop to the night position. By a similar operation the back of the berth is then dropped. Because the upper-berth tray is flat, more head room is available for the occupant of the lower berth.

The upper berth is restored to the daytime position by first lifting the rear side, completing the movement by lifting the aisle side of the tray. The berth is securely locked in day position because the supporting spindles and rollers are held in the ends of the guides by gravity a position from which they can be moved only by lifting through a slight initial elevation in the guides before they are free to drop to the night position.

Interior Decorations

The creation of the architectural and decorative treatment of the car interiors is the result of the collaboration of Paul F. Cret, Philadelphia architect, and S. B. McDonald, designing engineer and decorator of Chicago. Roger W. Birdseye, advertising manager of the Santa Fe, collaborated in the application of the southwestern Indian motif, especially in the observation lounge.

The result is that the interior decorations and upholstery of the new train suggest the country and the native traditions of the Southwest through which it operates. The colors follow those found in the land-

scape and in the Navajo Indian craft and ceremonial traditions. The Flexwood wall coverings of the sections, the drawing rooms, compartments and bedrooms are in a variety of rare woods, with adjoining surfaces painted in harmonizing colors. A few of the combinations are figured red gum, with flesh colored ceiling and mist taupe carpet; white harewood, with lemon cream and Vienna drab on other painted surfaces, and a jade green carpet; satinwood set off with blue gray, and a carpet in modern blue; redwood burl, with peach and blue-gray, and a mahogany carpet; Macassar ebony, with peach and light chocolate, and a Rumba carpet.

In the cocktail lounge two items of particular interest are the inlaid wood back bar ornament and the rug hanging over the desk at the opposite end of the room. The subjects displayed here are as a rule never executed in enduring mediums. These "sand paintings" as they are called are religious pictures which have lived between

Looking toward the rear end of the cocktail lounge

ceremonials only in the memory of the people. The rug is true Navajo, and the back bar inlay is an authentic reproduction.

The observation lounge in the last car also displays the work of the early southwestern Americans. The chairs and sofas are upholstered in a reproduction of native weaving, the original of which has been selected for museum display. The ornamentation of the pier panels employs authentic copies of sand paintings. These figures are executed in native colored sands and charcoal, exactly as Navajo prophets have made them for generations.

A photo mural of Navajo weavers at work on their looms hangs over the desk at the forward end of the observation lounge.

Electrical and Air-Conditioning Equipment

The electric power is 32-volt, d.c., supplied by Exide 850-amp. hr. batteries charged by Safety 7½-kw. body-hung generators with flat-belt drive from axle pulleys. Wire is carried in thin-wall steel conduits where practicable. In partitions the square steel structural tubing is fitted with adapters and used to carry the wires. The lighting circuits are protected with fuses in conveniently located and labelled panels.

All lighting is direct. The Safety fixtures are for the most part especially designed to present an appearance in harmony with the decorative schemes employed and to furnish satisfactory lighting.

Conditioned air, composed of a controllable amount of fresh air from the outside and recirculated car air, is supplied to all passenger occupancy sections of this train. Both fresh and return air are filtered through washable metal filters before being passed over coils for cooling or heating. The subsequent delivery by insulated metal ducts and through lighting fixtures furnishes air to all parts of the train occupied by passengers. Special branch ducts carry air to the berths of the sleeping sections.

The Safety-Carrier steam-ejector equipment is mounted below the car floor, and the cooling coils are mounted

Navajo "Sand Painting" figures on the observation wall

between the false ceiling and the roof. Vapor temperature-controls are fitted, and the ratio of fresh to recirculated air is controlled by manually operated dampers. Exhaust ventilators are fitted in the roofs over the toilets.

The passenger cars are equipped with the Vapor heating system. Individual thermostatic control is provided in each drawing room, stateroom and bedroom.

Water System

All service water for the passenger cars is carried in stainless-steel tanks, mounted under the cars, from which it is delivered by air pressure to the various outlets. The

system used in the dining car is similar, except for the addition of overhead storage tanks, one for hot water and one for cold filtered water. The water system in the railway post office and the mail-storage cars is similar to existing equipment; i.e., gravity feed from overhead tanks. Separate tanks are installed beneath the floor of passenger cars to carry the make-up water for the air-conditioning equipment. Filler inlets are placed in the sides of the car body to permit rapid and easy filling at the water stations.

Water coolers fitted with self-closing taps are located throughout the train for the convenience of passengers as well as in the kitchen and bar. The sleeping rooms are fitted with water carafes made on the vacuum-bottle principle and which the attendant will fill at the water coolers in the aisle.

All plumbing fittings and fixtures are of high quality. Washstands are vitreous china, colored to harmonize with the washroom interiors; hoppers are furnished with porcelain bowls, and the dental bowls are of the same material and color as the wash basins. All exposed piping is satin-finished chrome plated.

The trucks are four-wheel double-equalized type with Commonwealth integral frames and transoms of cast nickel steel, double annealed and drawn.

The frames are designed to withstand 200 per cent braking power. All bearing surfaces are carefully machined and all brake-pin holes are bushed with case-hardened sleeves. Surfaces subjected to friction are faced with manganese steel liners, and unfastened metal-to-metal contacts are insulated with sound-deadening material. The trucks on the first five cars are fitted with friction type bearings in Symington boxes with Magnus Company Satco bearings, the Freedom rolled-steel wheels on these being 35 in. in diameter. The trucks on the last four cars are fitted with American Steel Foundries roller-bearing units with SKF roller bearings. All axles are nominal 5½ in. by 10 in.

The coil truck springs are made of silico-manganese steel, and the elliptic springs of chrome-vanadium steel. Lateral movement of the truck bolster is dampened by the use of Houde hydraulic shock absorbers.

The cars are fitted with American Steel Foundries light-weight, high-tensile, controlled slack couplers, and Miner A4XB draft gears. The buffers are Miner B18X. The coupler-suspension guide, as well as the buffer stems, are Fabreeka surfaced.

All water, air and steam piping is made of soft heavy-wall copper tubing. Standard fittings are attached by the use of Parker adapter joints.

High Tractive Force and Large Tanks Feature

R. F. & P. 4-8-4 Locomotives

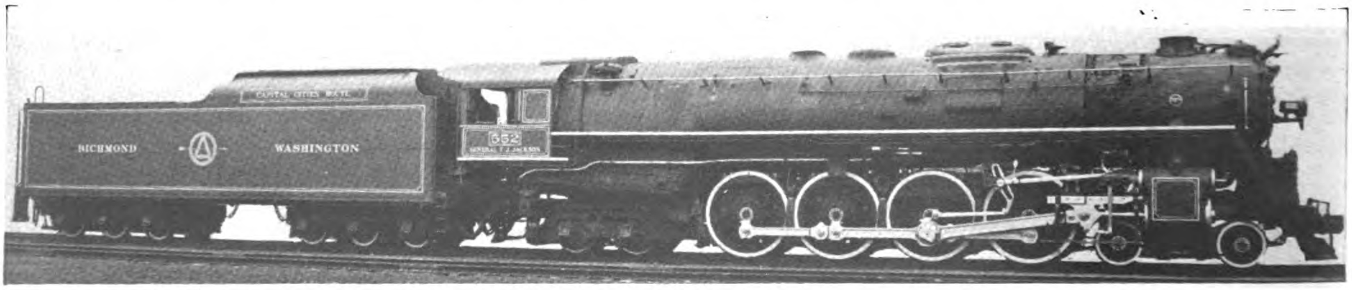
Five motive-power units, built by Baldwin, are designed for fast freight and passenger service; have 77-in. driving wheels and 20,000 gal. tender tanks

The Richmond, Fredericksburg & Potomac has recently added to its motive-power equipment a group of five 4-8-4 type locomotives built by the Baldwin Locomotive Works which have been especially designed to handle heavy trains on fast schedules over the 118-mile line between Richmond and Washington. This line is, in effect, a "bottle neck" between the South and the North and handles a large volume of exceptionally high-class traffic consisting chiefly of fruits and vegetables bound for northern markets and a large number of all-Pullman passenger trains during the winter months.

These locomotives are built with 77-in. drivers and have a tractive force of 66,500 lb., without booster. One of the five units is equipped with a trailer booster of 16,200 lb. tractive force and all have been arranged for the subsequent application of boosters. The tender tanks have a capacity for 20,000 gal. of water and 22 tons of fuel. They are designed to operate on curves as sharp as 18 deg., to meet a height limit of 15 ft. 6 in. and a width limit of 11 ft. 1 in. The maximum allowable weight per pair of driving wheels is 69,000 lb. The ratio of adhesion is 4.18.

Boiler and Boiler Accessories

The boiler has a conical ring in the middle of the barrel, with a maximum outside diameter of 98¼ in. Nickel steel, having a minimum tensile strength of 70,000 lb. per sq. in., is used for the shell courses, wrapper sheet (roof and sides), back head, and all inside and outside welt strips and liners. The firebox seams and the



The General T. J. Jackson, one of the Richmond-Washington Line's five new locomotives

seam around the firedoor opening are welded, and all tubes and flues are welded into the back tube sheet. There are two syphons in the firebox and one in the combustion chamber. The working pressure is 275 lb. and the boiler was tested under a water pressure of 344 lb. and a steam pressure of 330 lb.

The boiler accessories include Firebar grates and the Standard type HT stoker, with the stoker engine on the tender. The A.A.R. self-cleaning front-end arrangement is applied to three locomotives and two are equipped with the Cyclone front-end arrangement. The stack has an internal diameter of 23 in. and exhaust nozzles having diameters of 7¾ in., 7⅞ in. and 8 in. are furnished, provision being made for boring the nozzles out to a 10-in. diameter if desired. The superheater is a Type E, and an American multiple front-end throttle is built into the header. The feedwater heater is a Worthington, No. 5-Sa, of 9,000 gallons capacity, with the cold-water pump on the left side of the locomotive, back of the rear truck, and the hot-water pump mounted on the left-hand side of the smokebox.

Engine Bed and Running Gear

A one piece bed, furnished by the General Steel Castings Corporation, with air reservoirs, cylinders and back cylinder heads cast integral, is used in this design. The pistons are steel castings of the Z-type, and the guides are of the multiple-bearing type, with tinned surfaces. Bearing areas are so proportioned that the bearing pressure of the crosshead on the guide does not exceed 35 lb. per sq. in. Elfur iron is used for the cylinder and steam-chest bushings, the piston bull rings, the steam-chest valve bull rings and packing rings, and also for the stationary bushings on the main-rod back ends and the middle connections on the side rods. The rods are Standard Steel Works forgings, machined and polished. Walschaert valve motion is used, and is controlled by a Lewis Type A power-reverse gear. The valves have a steam lap of 1$^{7}/_{16}$ in. and an exhaust clearance of ¼ in. They are set with a maximum travel of 7½ in. and a lead of ¼ in., and cut-off takes place, in full gear, at 82.6 per cent of the stroke.

Baldwin disc driving-wheel centers are used on these locomotives. The centers are of special Double-Anchor high-tensile steel, cast by the Standard Steel Works. The Alco lateral cushioning device, arranged to provide a lateral movement of ½ in. on either side, is used on the leading pair of drivers.

Baldwin bearing metal is used for the rods and also for the driving, engine-truck, trailing-truck and tender-truck boxes. The American Steel Foundries roller-bearing unit is used on the front engine truck.

Miscellaneous Accessory Equipment

A mechanical lubricator on the right-hand side, operated from the top of the combination lever, has four feeds to the guides, four to the cylinders, two to the steam chests, one to the air pump, one to the hot-water pump, and one to the trailer truck. A two-feed hydrostatic lubricator has one feed to the stoker engine and one feed blank, except on the booster-equipped locomotive, on which the second feed is connected to the booster engine.

The air-brake equipment is arranged for the application of the Union Switch & Signal Company's two-speed continuous inductive automatic train control and train stop. The limiting speeds are 50 miles an hour in freight service and 75 in passenger service. The front engine truck is braked, as well as the drivers and tender trucks.

The tender frame is a one-piece steel casting of the water-bottom type, with the stoker support cast integral. The forged-steel tender-truck wheels and axles were supplied by the Standard Steel Works.

Particular attention has been given the appearance of these locomotives, and the finish and paint work, which includes polished machinery parts and a certain amount of color, are most attractive.

The locomotives are named after noted Confederate generals of the Civil War, the numbers and names being as follows: No. 551, General Robert E. Lee; No. 552, General T. J. Jackson; No. 553, General J. E. B. Stuart; No. 554, General A. P. Hill; No. 555, General J. E. Johnston.

The principal dimensions and weights of these locomotives are shown in the accompanying table. The locomotive illustrated is the General T. J. Jackson, No. 552.

General Dimensions, Weights and Proportions of the R. F. & P. 4-8-4 Type Locomotive

Builder	Baldwin Locomotive Works
Type of locomotive	4-8-4
Road Class	16-48-2/4-E, 106
Road Numbers	551 to 555
Date built	1937
Service	Passenger and fast freight
Dimensions:	
Height to top of stack, ft. and in.	15-6
Height to center of boiler, ft. and in.	10-7
Width overall, in.	11-1
Cylinder centers, in.	92-½
Weights in working order, lb.:	
On drivers	277,245
On front truck	86,725
On trailing truck	102,070
Total engine	466,040
Tender	376,900
Wheel bases, ft. and in.:	
Driving	20-0
Engine, total	47-0
Engine and tender, total	97-2¼
Wheels, diameter outside tires, in.:	
Driving	77
Front truck	36
Trailing truck	42
Engine:	
Cylinders, number, diameter and stroke, in.	two, 27 × 30
Valve gear, type	Walschaert
Valves, piston type, size, in.	12
Maximum travel, in.	7½
Steam lap, in.	1$^{7}/_{16}$
Exhaust clearance, in.	¼
Lead, in.	¼
Cutoff in full gear, per cent	82.6
Boiler:	
Type	Conical
Steam pressure, lb. per sq. in.	275
Diameter, first ring, inside, in.	86
Diameter, largest, outside, in.	98¼
Firebox, length, in.	144$^{3}/_{8}$
Firebox, width, in.	96¼
Depth at back, in.	73
Depth at front, in.	92
Combustion chamber length, in.	77
Thermic syphons, number	three
Tubes, number and diameter, in.	73, 2¼
Flues, number and diameter, in.	205, 3½
Length over tube sheets, ft. and in.	21-0
Fuel	Bituminous
Grate area, sq. ft.	96.3
Heating surfaces, sq. ft.:	
Firebox and comb. chamber	418
Arch tubes	19
Thermic syphons	114
Firebox, total	551
Tubes and flues	4,823
Evaporative, total	5,374
Superheating	2,093
Combined evap. and superheat	7,467
Tender:	
Style or type	Rectangular
Water capacity, U. S. gal.	20,000
Fuel capacity, tons	22
Trucks	Six-wheel
General Data, estimated:	
Rated tractive force, engine, 85 per cent, lb.	66,500
Rated tractive force, booster, lb.	16,200*
Total rated tractive force, lb.	82,700*
Speed at 1,000 ft. per min. piston speed, m.p.h.	46
Piston speed at 10 m.p.h., ft. per min.	218
Weight Proportions:	
Weight on drivers ÷ weight, engine, per cent	59.5
Weight on drivers ÷ tractive force	4.18
Weight of engine ÷ comb. heat surface	62.4
Boiler Proportions:	
Firebox h.s. per cent comb. h.s.	7.37
Tube-flue h.s. per cent comb. h.s.	64.5
Superheat surface per cent comb. h.s.	28.1
Firebox h.s. ÷ grate area	5.73
Tube-flue h.s. ÷ grate area	50.1
Superheat. surface ÷ grate area	21.7
Comb. h.s. ÷ grate area	77.6
Tractive force ÷ grate area	692.0
Tractive force ÷ comb. h.s.	8.91
Tractive force × dia. drivers ÷ comb. h.s.	686.0

* Only one of the five locomotives is equipped with booster.

How Victorian State Railways

Train Apprentices

By Donald Cameron*

Several unusual methods are incorporated in the very thorough plan which is now in effect

THE Victorian State Railways have for many years past trained the great majority of their own craftsmen, and it is generally recognized in the Commonwealth of Australia that their system of training apprentices to become high-class tradesmen is second to none on that continent. Many of the leading positions in large private engineering establishments and other government departments are filled by men who served their apprenticeship with the Victorian Railways.

3,200 Apply for 70 Places

The field of selection for apprenticeship is wider than that in industry generally. Under the Railways Act applications must be publicly advertised throughout the state and all the eligible candidates must be interviewed by an independent board of three selectors (usually comprising a member of the staff board and two departmental engineers) appointed by the Governor-in-Council. To be eligible for appointment, lads must be between 15 and 18 years of age, unless they hold the diploma or intermediate certificate of a technical school, or the intermediate or school leaving certificate of the University, in which event they are eligible so long as they have not reached 19 years of age.

The selectors are not permitted to acquaint themselves with the name of any applicant, who is known to them by number only, and no person is permitted to make representations to them. The number selected must not exceed twice the number of vacancies, and selected candidates who pass the qualifying educational and medical examinations ballot to determine the order of appointment to the vacancies. Those who do not succeed in obtaining immediate appointment are eligible without further application or selection to fill any other vacancies which may arise during the ensuing twelve months.

Country lads who are obliged to reside away from home while serving their apprenticeship are granted an allowance in the earlier years over and above the ordinary wage towards the cost of their board and lodging. The positions are very much sought after and in 1934 we had 3,200 applications for 70 apprenticeships.

Technical Instruction

During the first three years of their apprenticeship, the lads are given part-time technical instruction during working hours, either at the Departmental Technical College, which is situated close to the main metropolitan workshops, or at the local technical school in the case of those located at country workshops. The apprentices are graded in classes according to their previous educational and technical qualifications. The cost of this instruction is paid by the department. Most of the apprentices attend evening technical classes, in addition, at their own expense. The Railways Technical College is in charge of highly trained technical instructors selected from the state education department, and a keen personal interest is taken by the instructors in the welfare of the apprentices under their control.

Apprentices in the higher trades who obtain the best all-round results are eligible each year for monetary prizes and for two or three scholarships which entitle them to attend the full four years' day course at the Melbourne Technical College for the diploma of mechanical or electrical engineering. A scholarship is also open each year for the best all-round apprentices to enter a course for the degree of bachelor of mechanical and electrical engineering at the Melbourne University. The scholarship winners are paid a salary of approximately $600 per annum and, after graduating, are promoted to the junior professional staff and then become eligible for future advancement to higher professional and executive positions.

A supervisor of apprentices is responsible for keeping in touch with all apprentices and their foreman. He checks up to see that they receive proper training in the all-round duties of their trades. He also acts as a "father" to the lads and devotes special attention to those who are living away from home. A report is furnished to the parents every term showing the progress made by the apprentices at their work and in their technical studies.

Visits to Other Plants

Every year a party of from 15 to 20 apprentices is selected to visit leading engineering establishments in other States. They are accompanied by the principal of the Technical College and the supervisor of apprentices, and each is required on his return to submit a paper setting out his impressions of the establishments visited. They are furnished with free transportation and are paid their wages and expenses. The establishments visited include such places as the modern steel works of the Broken Hill Proprietary Company at Newcastle; large electrical power houses; car-building workshops; locomotive workshops; electrical apparatus factories and such like.

These visits have been most helpful in widening the outlook of the apprentices and in developing their powers of observation. They have led to the establishment of a Junior Artisans' Society which organizes visits at week ends, holiday periods, and in the evenings to leading business establishments. This society has developed greatly and has assisted in promoting a spirit of pride in the job.

The system of yearly visits by apprentices to other States has been followed by the neighbouring state rail-

* Mr. Cameron is chairman of the Railways Staff Board and is responsible for the general supervision of matters relating to the appointment and training of apprentices. He visited U. S. A. in 1927 with an Australian Industrial Mission, appointed by the Commonwealth Government to study industrial conditions. He remained in the United States and Canada for several months studying railroad practices.

ways of New South Wales and South Australia who have found it advantageous.

Encouraged To Travel Abroad

When they have served their time, apprentices are encouraged to travel abroad to widen their knowledge and experience, and they are granted extended leave of absence without pay for this purpose with a guarantee that their jobs and seniority will be conserved during their absence. Many have visited the United States of America and other countries and have been afforded facilities to acquire experience through the courtesy of leading railroad and engineering companies in U. S. A. and overseas. Many others have been granted leave to gain experience as marine engineers on overseas boats.

The Railways' Administration regards its apprentices as a valuable asset and is always willing to do anything within reason to help them to become efficient. This is appreciated by the apprentices themselves, and the great majority of them remain with us and adopt the railways as their career.

During the depression it, of course, became necessary to suspend the appointment of apprentices in the railways as in private industry, but with the improvement in economic conditions, the appointment of apprentices at regular intervals has been resumed.

Essentials of

Journal-Packing Specifications

By J. J. Callahan*

What should the railroads do about journal-packing specifications? The author's views on the essential qualities and required inspection of packing are pertinent to this problem

THE important point in the lubrication of a car journal is to get the lubricant on the bearing surface. The less it costs to do this efficiently, the better for the transportation industry. One thing favorable to the present standard system, in which the medium for oil conveyance is textile material known as packing waste, is that it has a low initial cost. Its ultimate cost depends, of course, on its efficiency, about which we do not know very much, because no sincere attempt has ever been made to develop this to its highest state of perfection.

Of all the phases of the standard car-journal lubricating system, the medium for conveyance of the lubricant to the bearing surface has received the least attention and is the least understood. If anybody knows exactly what the medium of oil conveyance in the standard system should be to achieve its highest purpose, they have not published what they know, not at any rate, in the place where it would most reliably be expected to be found. There is not a specification for car journal packing that it satisfactory, and there are some that are very poor.

It might be supposed by the uninformed that if he took what is perhaps most recognized as the best official journal packing specification, and submitted it as is, which is frequently done, to an unknown dealer who had never made packing waste for him before, the required material would, without further delay or inconvenience, be immediately forthcoming. Nothing could be further from the truth, and such a very uninformed person would have quite a little to learn about the uncertainties of car-journal packing. This is not the fault of the dealer who cannot very well make material when he does not know what to make.

Instead of promptly preparing the material as called for in this indefinite specification, the dealer will invariably endeavor to obtain a sample of the waste in use, and after securing it he immediately prepares a packing to match the quality and appearance of the sample, which means that he makes the waste to meet a price and not to the specification submitted. How this gets by is simple enough—nobody knows the difference. If they do they cannot prove anything because almost any conglomeration of textile threads will meet the requirements. The only reason the dealer asks for a sample is to play safe. It is true that the specification was never intended for use in just this way, but, nevertheless, that is the way it is being used.

The Inspection of Journal Packing Waste

When a purchaser receives packing waste he cannot verify its quality as stipulated in the usual specifications. It is even doubtful if anybody tries. The very fact that railroads, claiming to know that waste purchased by them meets the terms of their specifications, rely for their knowledge on the unnecessary expense of personal inspection during manufacture, is a glaring admission of inability. It is very doubtful if they can verify the quality of packing waste to the terms of the usual specification even by a plant inspection.

Plant inspection of journal packing is a sort of policing operation in which the inspector inspects by standing around in the dealers plant asking questions perhaps, and watching the dealer to see that he actually puts into the packing mixture what he, or some other dealer, has already showed to the inspector as the proper material required by the terms of the specification. The strange part is that the dealers rather like this affair. Everybody likes it. There are at present but a very few of us who do not like it.

Only the psychic individual can look at the textile material and discern the true wool or cotton content of the finished packing. Only the same kind of person can tell the content of threads below a certain limit as laid in the mix, if there is any value at all in knowing the

* *Chief Chemist, Boston & Maine Railroad.*

length as laid in the mix or after being mixed. Only such a person by inspection can separate the finished packing into its component parts of Axminster, ingrain, or Brussel, grades of merino, camel hair, cop, spooler or slasher, that is, presuming he can even identify these fibers in their varying grades of quality.

To determine definitely the important constituents of packing waste, reliance must be placed absolutely on laboratory examination. Therefore, if you want definite information, and that is what you must have if you really intend to do anything, you must make a laboratory examination which is the only reliable and the only kind of inspection necessary or needed. Plant inspection of a kind may have merits where it is but a matter of simple mechanical measurements, but when it comes to invisible requirements to be determined by indirect means and methods not entirely simple and mechanical, a certain method of technique is needed that is not likely to be acquired from shop, yard, enginehouse or drawing board. Hence, why bother at all with plant inspection of journal waste which is after all but a futile gesture in the wrong direction.

The Medium for Conveyance of the Lubricant

However, the real important matter is to get the lubricant on the bearing, both efficiently and at low cost. The low-cost way is the old way. How efficient is the old way remains to be seen. It has done very good work for very many years. Perhaps it has greater possibilities. It deserves, at any rate, more consideration than it has received in the past.

The most neglected part is the medium for conveyance of the lubricant. Nobody will tell why it is neglected, but everybody will tell you its faults, even to including things that are not its fault. All of which improves the material not at all.

Whether every railroad has different ideas, or any ideas, of what exactly the best medium should be, is somewhat uncertain. What is certain is that each railroad favors a different preparation, and since they not only favor it, but use it extensively in actual service, they must feel that their particular preparation is right. Some of them may be right, but they cannot all be right when they are so different.

While there are those who believe that such variation is all wrong and that one standard preparation should be used, it is perhaps as well that some difference exists in the grade of journal packing used by railroads. There are substantial reasons for doubting that the same identical grade for all roads would be of any great advantage.

The subject of interchange is too frequently brought into the matter as an example of why things cannot be done. One hears plenty about what can't be done, but not so much about what might be done. The way to avoid the complications of interchange journal-box packing is not to have car journals packed by foreign roads. This, of course, is impossible, but it is not impossible to keep the packing of journal boxes by foreign roads at a minimum, and this is the next best thing. To keep this at a minimum, pack your own car journal boxes at the end of the required period whenever possible, and use a grade of packing waste that insures operation for this period or longer. The longer the better and anything that can be done towards this end is a step in the right diretcion.

If you pay for a good grade of packing you certainly want to know that you get it. There is only one way to do this. State definitely what you want and then see to it that what you get meets the requirements. It is easy enough to make statements of what you think you want, but it is not so easy to determine that what you get is what you need.

The trouble with specifications of railroad car-journal packing is that they require everything, and provide for the verification of nearly nothing. There is a wide and complicated variation of textile yarns. The selection and machining of a profitable journal packing at competitive prices is an art. Most of the artists have been long in their careers. The business of a railroad is transportation, not the manipulation of textile yarn. To specify in journal packing what can be definitely ascertained as required for efficient transportation is one thing, but to presume to regulate the refinements of an art with which one is neither familiar nor concerned, is only a waste of time and effort.

The Four Essentials

There are but four things of interest to a railroad in the qualifications of a good car-journal packing. They are purity, durability, oil absorption and resiliency. On these four points rests the efficiency of the medium for conveyance of oil to the bearing surface.

Upon these four points a railroad should concentrate its efforts, for on these and these alone are the standard and specification of quality for journal packing founded. The adoption of a standard based on these points, and the verification of it, is the concern of the railroad. With what materials, and by what means the required standard is produced, is no concern of theirs. That is the problem of the packing manufacturer.

By purity of journal packing is meant freedom from foreign substances which are likely to be injurious or interfere with a free flow of oil to the bearing surface. This includes metallic substances, straw, paper, wood, water, grease, or mineral abrasive matter. Most foreign substances are fairly well removed from the waste in the process of machining. All textile yarn contains a certain amount of water, grease and dirt. A small amount cannot be helped and must be tolerated, but when buying textile yarn you surely do not want to pay for any more water, grease and dirt than is necessary. Accurate methods for the determination of water, grease and dirt have been developed, and control of these constituents presents no difficulty.

The durability of journal packing concerns its ability to resist the destructive forces of service. It involves physical qualities of the threads, their strength and resistance to wear, and has to do with a considerable part of the packing and repacking costs.

If one has plenty of cash, and time is of no value, one can buy a nice looking cheap suit and throw it away when it soon begins to look shabby. A railroad can do the same with packing waste—the only difference is the scarcity and greater value of time, and the larger amount of ready cash required. Perhaps you would not buy shoddy suits, but perhaps you do buy shoddy packing waste. How do you know you do not? You certainly cannot rely on any present railroad specification. Some specifications actually specify material known to be of questionable durability. Have you ever seen anything in any journal packing specification that provides proper protection against the nondurable? Yes. Something to this effect: "The use of reworked threads or muck yarn is prohibited. Waste shall consist of new threads the product of looms, etc., etc."

Is this proper protection against the nondurable? It certainly is not. How can one tell from this whether a thread is reworked, made of muck yarn, new or not new, without taking somebody's word for it? True, if the thread appears to be weak, you can call it old, but you are only guessing. We are attempting to secure

packing that will give the longest service in the journal box at the lowest cost, and you can't do that by guessing.

The supposed protecting provision is too indefinite. It discriminates by name with no means for proof that the material is of the name. Why bother with names at all in a specification. We are concerned not with names but with durability. The thing to specify is a quality that will insure durability regardless of the name.

How to provide in a specification for a definite quality that will insure the receipt of durable packing waste is a problem for research. Perhaps it can be done by direct or by indirect means, or a combination of the two. Something better for the purpose is surely possible, but as far as known no railroad has in this matter ever attempted to find anything.

The importance of thread length is not so much what they are as laid in the mix, but what they are when mixed in the journal box. It is not the precise length of a few threads, but the general length of all the threads that is of significance. Suppose a waste contained no threads under 6 in. long, and no threads over 9 in. long. It would meet the requirements of any journal-packing specification, but not the requirements of a good journal packing.

Materials which do not absorb oil are of no value in conveyance of the lubricant to the bearing surface. There is a considerable difference in the oil absorption of the various substances used in packing waste. Some materials absorb oil very slowly, if at all. Others take up oil quite rapidly and release it nearly as fast. Much depends on the nature of the substance or the artificial characteristics imparted to it by some manufacturing process. Tightly spun threads for instance, will not have the absorption of threads loosely spun. Hard slasher threads do not have the absorbing power of soft spooler. Wool yarn may absorb oil slower than some cotton yarns, but once the oil is absorbed the wool retains it better.

The ideal material for the purpose will absorb the oil rapidly and release it slowly. Under such ideal conditions there is always lubricant present in the threads to be extracted by the revolving journal. What is this material or combination of materials that comes nearest to the production of the ideal? There are numerous opinions with little that is substantial for their support. The usual method of determining the oil absorption is not entirely satisfactory. Refinements in the method are needed.

One of the most important characteristics of journal packing is resiliency. All the purity, durability, and oil absorption, is of little value if the packing lacks in resilient qualities. It is the resiliency, and the resiliency only, that insures contact of the packing with the journal surface, and without this contact, there can be no conveyance of the lubricant to the bearing surface.

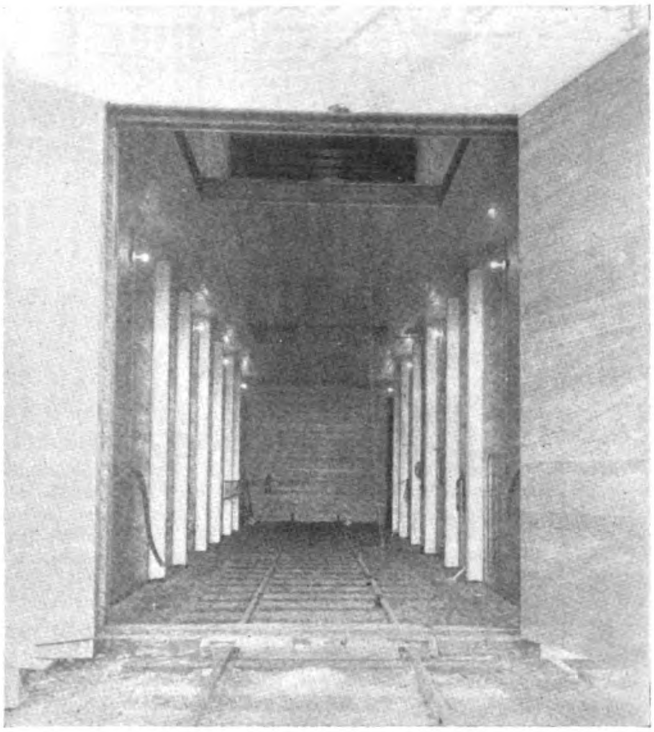
How much resiliency is needed? How can we know that we get it? Nothing but the proper kind of investigation will ever answer these questions.

Let each railroad work out these problems of journal-waste specifications for their own conditions of operation and costs. Some will see the advantage of improvements in the present standard journal-lubricating system and realize the value of efficient uniform packing. It has a part in reducing cost of hot boxes, necessity for jacking and repacking, and effects a saving by a greater yield of better reclaimed packing.

Whether or not these problems can be successfully solved remains to be seen. A more satisfactory specification for journal packing is most certainly needed, but before such a specification can be written, it will first be necessary to learn what to write. This will mean a certain amount of research, requiring both time and expense, but offering the prospects of a specification based, not on intangible terms assumed to provide for the proper material, but upon definite qualities which are desirable in packing for the efficient conveyance of the lubricant to the journal and the bearing surface.

Insulated Building for Testing Refrigerator Cars

The Fruit Growers Express Company recently completed the construction of an insulated building at Alexandria, Va., covering a standard-gage railroad track, in which refrigerator cars can be placed for testing under heat or cold. A short section of the track, passing through the entrance doors, is removable. After a car is placed in the building for test, the removable portion of the track is lifted out and replaced with an insulated block that completely fills the vacant space. The edges of the entrance doors have rabbitted stiles, thresholds and headers, all edges being insulated with special rubber gaskets to insure tight joints.



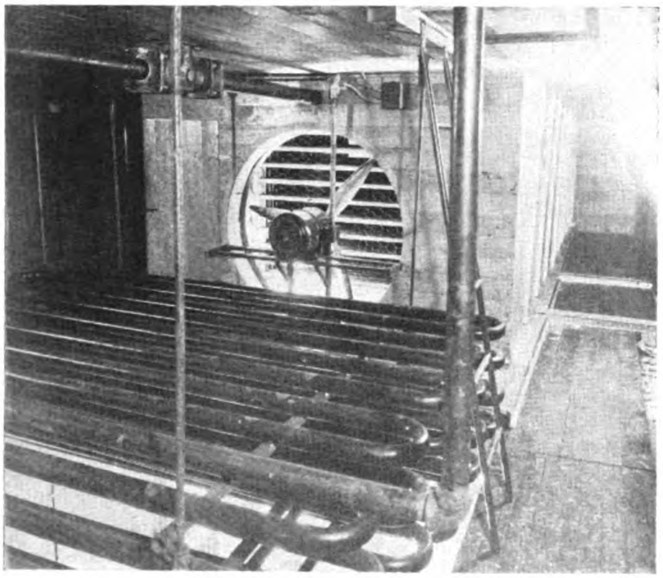
Interior of the test room showing doors open with track block section at end of building under door in place

The test room has an inside clear length of 58 ft., clear width of 16 ft. and clear height of 15 ft. Any present-day refrigerator car can be placed in it for testing. The building is of wood construction with steel reinforcements for supporting fans, motors, coils, etc., which are provided for heating or cooling the room as desired. The sides, ends and ceiling have 8 in. of efficient insulation; the floor contains cinder fill. The exterior of the sides, ends and roof are covered with asbestos wall and roof shingles. The building is provided with equipment that will produce air temperatures from —10 deg. F. to 150 deg. F. as desired within approximately five hours after the machinery is started. The test house is located adjacent to an ice manufacturing plant from which steam for heating and refrigerant

for cooling the building is furnished by direct connections.

The building was designed and equipped to develop and maintain positive known temperatures required to conduct tests of various kinds for the purpose of developing improvements in perishable protective service. By its use the efficiency of refrigerator cars of different construction, new types of material, new forms of insulation, and improved devices purporting to give more efficient results in icing and heating cars may be thoroughly tested for the purpose of determining efficiency and desirability of use.

The building is provided with a chamber adjacent to the test room for housing test instruments and taking temperature records. The temperatures of the car under test and the test room may be taken at will with electric resistance thermometers from leads passing from the



Interior view taken on the floor above the test chamber—The heater coils are shown in the foreground, between which light from the test chamber below can be seen—The 48-in. three-blade blower fan can be seen mounted in a partition, forming the end of the refrigerating coil duct, the pipes of which can be seen back of the fan

side of the building into the adjacent chamber through an insulated opening without entering the car or test room.

A test of the resistance of the insulated walls of the building to the transfer of heat was made by placing maximum-minimum thermometers in the building and keeping it closed for a two-week period with the refrigerating and heating equipment idle. The outside temperature during this test fluctuated from 20 deg. F. to 59 deg. F., a range of 39 deg. F., while the temperature in the building remained between 37 and 44 deg. F., a range of only 7 deg. F. On one occasion when the room was under refrigeration, the room temperature was held substantially between —8 deg. F. and —12 deg. F., for approximately six days. On another occasion, while the building was being heated, the room temperature was held substantially between 93 deg. F. and 97 deg. F. for nine days. The outside temperature during these tests ranged from 33 deg. F. to 70 deg. F.

The refrigerating and heating units were supplied by the Frick Company, Waynesboro, Pa. The temperature control is operated by hand valves when the building is under heat, but it is controlled by thermostats when under refrigeration. The refrigerating unit consists of 2,500 sq. ft. of cooling surface. The heating unit consists of 385 ft. of 2 in. heater pipe in a compact coil. Two direct-driven 48-in. Meier Nuair fans, each having a capacity of 20,000 cu. ft. of air per min., are located adjacent to the coils. When in operation they force air rapidly over and through the coils, circulating the driven air to all parts of the room through ducts provided for that purpose. The total space in the building is 20,764 cu. ft., less the space occupied by the coils, fans, machinery, deck and car under test. As the capacity of the fans is 40,000 cu. ft. per minute it will be seen that several changes of air per minute can be effected.

Unique Sketching and Drawing Board

The illustration shows a light-weight Bakelite drawing board which has the unique feature of permitting the user to make accurate drawings and sketches without the aid of a T-square. The board is designed with squared edges, which form the border of the board, and with spring paper clamps in the slotted corners. The spring clamps are so shaped that they elevate the corners of the triangle above the squared sides, thus permitting free movement of the triangle beyond the limits of the board. Therefore, with only the aid of a set of triangles all vertical, horizontal, and angular lines can be drawn. The paper is held on the board with the corner spring clamps, the tension of which can be relieved for removing the paper by means of finger

Board for making sketches and drawings without the aid of a T-square

pressure on small buttons provided on the back of the board. The drawing boards are made accurately within reasonable limits, and accurate drawings can be made with them if accurate triangles are used.

The drawing boards are made to accommodate 8½ by 11-in. letter-size paper, 9 by 12-in. standard-size drawing paper, or 10 by 15-in. patent-size drawing paper; the dimensions of the boards are approximately 2-in. longer and wider than the paper each accommodates. Other sizes however are made to order by the manufacturer, H. E. Townley, Riverside, Calif.

SWITCHMAN—ARTIST.—John Adams, switchman for the Southern Pacific at Roseville, Cal., is also an artist, the only one of his kind in the world. Adams makes sand pictures in bottles, using a wide variety of colored sand and achieving some remarkable effects. So unusual is his hobby that it has been recorded in the movie series "Strange As It Seems."

EDITORIALS

To Boiler-Shop Supervisors

With this issue the *Railway Mechanical Engineer* resumes attention to the problems of the locomotive boiler shop and locomotive boiler maintenance which it relinquished to the Boiler Maker and Plate Fabricator when that publication became a member of the Simmons-Boardman family in 1919. The *Railway Mechanical Engineer* will endeavor to give the same attention to the boiler shop and to the problems of boiler design and construction that it does to the problems of locomotive design and construction, maintenance and repairs of interest to supervisors in the machine shop, erecting shop and other locomotive shop departments now dealt with in leading articles as well as in the Back Shop and Enginehouse department.

We shall endeavor to merit the good will of railway boiler-shop supervisors and shall welcome their criticisms and suggestions.

Apprentice Training Abroad

Several innovations in the apprentice-training system of the Victorian State Railways, which is described on another page, will be of interest to our readers on this continent. The Victorian Railways are quite deliberately planning to furnish an ample supply of thoroughly trained workers to meet future requirements. From these young men, as they go through their course, selections are made of those whose abilities and personalities promise to fit them for higher positions.

Among the unusual features are special compensation for boys from the country districts who must live away from home while they are learning the trade, scholarships for those who excel in order that they may secure a college training, and organized inspection visits to industrial and railway plants in adjacent states by those who measure up to certain qualifications. Finally, the graduate apprentices are encouraged to travel abroad to widen their observations and experiences.

The Victorian Railways, like those in this country, were forced to minimize their apprentice training activities during the depression. Now that that is behind them, they are approaching the problem with renewed vigor. Some railroads in this country are beginning to take a more active interest in apprentice training, but unfortunately are not showing nearly the same initiative as are those in charge of the Victorian State Railways. Both industry and the railroads today are seriously embarrassed because of the shortage of skilled labor. Thousands upon thousands of people who are now on relief, could be rendering worthwhile service if they had been trained for some trade or specific vocation.

The Victorian Railways apparently aim to train a large enough number of workers to supply their own needs and leave an oversupply of trained workers who can enter other industries. The Victorian Railways are government owned, but what a wonderful thing it would be for the American railways if they could not only take care of their own requirements, but could help to supply industry in general with well-trained workers. Surely there would be a far more sympathetic attitude on the part of industry toward the railroads and the difficulties they find themselves in because of over-regulation as compared with competing types of common carriers, which are in fact partially subsidized.

There have been times in the past when a few American railroads have set the pace in introducing modern apprenticeship methods. They were well paid for their efforts in improved and more efficient production; moreover, some of these men who graduated into industry have been among the strongest and most intelligent champions of the railroads in their fight to improve their condition and to maintain themselves as the backbone of American transport.

In Days When Machines Were Young

Some years ago when a certain large mid-western locomotive shop was first opened, a double back-geared lathe was installed, along with other machinery. Naturally it was a busy time for everyone, breaking in new machine tools and a lot of new men, while at the same time scheduling an output.

As the machine-shop foreman was instructing a new man how to operate a Morton draw-cut cylinder planer, and incidently trying to teach himself about it, he felt a tap on the shoulder from "Scotty" McDonald who had that morning started to work on the double back-geared lathe, and the following conversation took place:

"Well! What is it?"

"There's a tooth bruk on the gear of yon lathe."

"Well, too bad, but get busy. You can peg it yourself can't you?"

"Yus zir, I ken, but the gear that runs into it bruk as well; there's twa teeth outa thet and one of the gear arms is cracked too."

"Go and get Tommy Bell, the maintenance foreman, to send a man out to help you, and both of you keep busy. Got to have that lathe going tomorrow morning. I'm too busy to go with you."

"There's naw use sir, the twa arms that has the

bearins cast solid to the lathe heed and the gear that runs in them is bruk as weel—the whole G--D mess is leein on the flure you see."

"Oh well! Guess I'd better go and have a look at it myself."

Sure enough, the foreman found one tooth out of one of the gears all right, but the bearing arms and all the other gears were in just the sort of a mess "Scotty" described. He only wanted to break the news as gently as possible.

The days are largely past when gear teeth and other parts of modern machine tools break, although it is a fact that many a machine with a cracked base, welded head, or patched-up gear drive is still being nursed along in railway shops to the great detriment of output, not to mention the foremen's peace of mind. New tools, utilizing the modern advances in metallurgy and the long experience of specialized designers break only under the most unusual circumstances and have production capacities, using the best of modern cutting tools, of 10 to 1 as compared to some of the older tools.

Shop Men Should Know Material Costs

Locomotive and car maintenance costs usually constitute 60 per cent labor and 40 per cent material, although the 60-40 ratio varies considerably on individual jobs. This means that the primary emphasis in railway locomotive shops, car shops, engine terminals and car-repair tracks should be on the installation of labor-saving machinery, equipment, tools and methods. Of hardly less importance, however, are the possible economies through conservation of materials.

There is really a woeful ignorance on the part of many workmen and supervisors of the cost of materials and parts in everyday use in the repair shops. Take commodities, for example, such as glass, paint brushes, nuts, monkey wrenches, files, emery cloth, machine oil, waste, Stillson wrenches, pipe fittings, rivets, bar iron, steel billets, etc., and ask the first six men who are continually using them, and not one can give even the approximate price of any of these items. Shop foremen are often little better informed. Some will not even hazard a guess, and most of those who do are generally far and away too low in their estimates.

The inescapable conclusion is that, not knowing material costs, shop men and even foremen, in general, do not fully appreciate the necessity of using materials efficiently and with the greatest care and avoiding every possible wastage. Some roads have taken effective means to acquaint shop men with detail material costs, and responsible mechanical-department officers should constantly urge the wider dissemination of information of this character.

Car Department Officers Meeting

During the year 1935 Class I steam railways, excluding switching and terminal companies, expended $144,-676,000 for repairs to freight-train cars; $51,302,000 was expended for repairs to passenger-train cars. This does not, of course, by any means measure the total expenditures made under the direction of the car department. It has other functions to perform and several thousand new freight cars were also built in railroad company shops.

Obviously there are great possibilities for savings where such large expenditures are involved, through providing the best type of supervision and by taking advantage of every possible improvement in administering the various details involved in the design, construction and maintenance of car equipment. Beyond this, however, the mechanical and car-department officers can be extremely important factors in increasing the business of the railroads, through providing and maintaining equipment which will make competition with other types of carriers more effective. Car-department officers, if they are to make the best of their opportunities, must take advantage of every possible opportunity to find the best solution for these problems and most effectively administer their departments.

Today the Mechanical Division of the Association of American Railroads is concerned with matters relating to the design of car equipment and the establishment and maintenance of standards and recommended practices. The latter include the numerous and complicated problems relating to the interchange of equipment. Beyond these, however, there are many other important aspects of car department operations which receive little or no attention from it. There is, therefore, a large place for an organization of car-department officers, which will investigate, study and discuss problems relating to the best methods and practices for maintaining and rebuilding car equipment. This would include a study of the machinery and equipment for repairing the cars, and the best arrangements and the most efficient methods of operating car repair shops and yards.

The most important factor in any organization is the human element. It is true that industry has given much study and attention to the best methods of dealing with the worker and to directing his energies, and yet, unfortunately, the problem of training and educating workers and of dealing with them, so that they may become a loyal and effective group, has not received much special attention in the mechanical department, and particularly in the car section. It would seem, therefore, to be of special importance that the car-department officers should organize effectively to study these problems and to compare methods and practices, in order that the whole standard of operation of the car department should be raised to the highest possible level.

The Car Department Officers' Association, like most of the other minor mechanical-department organizations, was forced largely to discontinue its activities during the depression years. Its officers, however, are not asleep to the opportunities which lie before it and are now working actively and aggressively to develop a program for the meeting which is scheduled at Chicago, September 21 and 22. There are such tremendous possibilities in having it function efficiently in the interests of improved railway operation, that no stone should be left unturned to make this meeting a big success and to re-establish the work of this association on a sound and substantial basis.

There are other ways, of course, in which it can be helpful. The Mechanical Division has been looking to the various car foremen's and car inspectors' groups scattered throughout the country for facts and suggestions which will help to improve the interchange rules. The Car Department Officers' Association has also had a part in this work, but because of its personnel, might well function more effectively in these matters before they are finally acted upon by the Mechanical Division. Be that as it may, there is an important place for the Car Department Officers' Association, even if it does not function at all in this respect, although it is understood it will give considerable attention to interchange matters at its meeting in September.

Do Modern Machine Tools Really Pay?

The question as to whether the installation of modern machine tools in a railroad shop really pays is one that is difficult to answer without an accurate analysis of the conditions under which they are to be used. The relative lack of detailed information concerning machine-tool use in railroad repair shops as compared to many industrial plants makes it seem at times that the railroad man is not particularly interested in detailed costs. It is therefore highly encouraging to find that most roads, faced as they are with the necessity of expanding shop operations, are now giving serious consideration to programs of machine-shop rehabilitation that will enable them to cut the cost of machining locomotive parts.

More encouraging is the fact that the roads which have purchased a number of new tools over the past year or two have done so only after the most careful analysis of present methods and costs. The new tools that are now producing substantial savings are able to do so because they were purchased to do a specific job and expected to develop specific results.

One Eastern railroad, about a year ago, requested a manufacturer of turret lathes to have one of his engineers, experienced in production work, make a detailed study of all of the turret-lathe work in a certain department of the road's principal repair shop with the result that, where thirteen machines, most of which were over 20 years old, were formerly being used, six new machines of modern design are now being installed to handle an increased volume of work. Here is evidence of the faith of a mechanical officer that modern machines do pay.

In another case a railroad, after careful analysis back in 1935, had estimated that it could install approximately 30 machine tools to replace obsolete equipment and pay for the new machines in from four to five years out of savings if they could be operated on an average of 16 hours a day. How nearly this has been accomplished is told in a report on the performance of this equipment furnished by that road within the past two weeks. The new machines have now been in operation approximately 18 months and, at the end of April, 1937, had accumulated savings of 25.8 per cent on the original investment in spite of the fact that business conditions during that time had made it impossible for the tools to be kept busy more than from 34 to 47 per cent of the time. During the past twelve months these machines have saved 22.9 per cent on the investment; in one month of the twelve the savings attained were at the yearly rate of 26 per cent and in three of the twelve the savings exceeded that yearly rate. Two things stand out in this record of performance: First, that the economics of actual service have been eminently satisfactory in spite of the fact the machines have been used less than half of the anticipated time and, second, that the actual results have justified the time spent in making a thorough analysis of previous methods and costs. Here, at least, is one road with sufficient evidence in its own records to answer affirmatively and emphatically the question, "Do Modern Machine Tools Really Pay?"

NEW BOOKS

ENGINEERING REPORT ON AIR CONDITIONING OF RAILROAD PASSENGER CARS. *Prepared by the Division of Equipment Research, Association of American Railroads, 59 East Van Buren street, Chicago. 316 pages. Price to member roads of A. A. R., $1.50; to others, $3.*

The Summary Report on air-conditioning issued on November 24, 1936, dealt with those factors of air-conditioning railroad passenger cars of direct concern to the railroad executive. The Engineering Report, the second of the series, is designed to meet the needs of the air-conditioning engineer and railroad operating personnel. In it the results of laboratory tests and of road performance tests of cars are presented in four parts: Part I—Tests of Air-Conditioning Systems; Part II—Tests of Drive Mechanisms; Part III—Hot-Room Tests of Air-Conditioned Cars, and Part IV—Road Performance of Air-Conditioned Cars. The subject of costs is not dealt with in the Engineering Report but is discussed in detail in Part V of the Summary Report.

THE READER'S PAGE

Some Answers To the Valve Problem

To THE EDITOR:

The tough valve problem on page 221 of the May issue does not appear to be so hard to solve. I made a drawing to a scale of 1/8 in. to the foot and found that all parts of the gear were within and not exceeding the allowed angles from the crank up to the combination lever. I believe that with the proper setting the compression kick can be stopped.

The 18 9/16-in. eccentric crank with a 20 11/16-in. throw will give a constant lead. An eccentric-crank throw of 21 5/8-in. with an 18 9/16-in. crank will delay the cut-off if the crank is moved out after the cut-off has been checked with a throw of 20 11/16 in., because the valve travel will be longer. This will also increase the lead in the corner and up to the center. If the crank is moved out, this would delay the cut-off to about 30 per cent; to get a cut-off of 25 per cent the reverse lever would have to be hooked up about one notch closer to center. In other words, increasing the lead hastens all valve events so that point of preadmission occurs earlier, cut-off is earlier, release is earlier, closure occurs earlier, the admission period is unchanged, expansion begins earlier but the period is unchanged, compression is earlier with the period unchanged, and exhaust earlier with its period unchanged. It would be better to change the combination lever and let the crank stay at 20 11/16 in.

C. J. McCREADY.

Is This the Solution?

To THE EDITOR:

When reading the valve-gear problem of K. B. G. in the May issue one or two points occurred to me. The lap, lead, exhaust clearance and full-gear travel given, are exactly as for the C. M. St. P. & P. 4-4-2 high-speed engines described in the June, 1935, issue of the *Railway Mechanical Engineer*. One would hesitate to criticize these characteristics, as we presume the Hiawatha locomotives can be operated at 25 per cent cut-off, but inquiries on this might prove interesting. On the other hand, the clearance volumes as a percentage of the piston displacements will differ and the 27-in. cylinders will have more clearance than the 19-in. cylinders of the Milwaukee engines. I believe the 27-in. engines have not enough compression at 25 per cent cut-off.*

I would suggest altering the lap-and-lead levers to give 1/4 in. lead and 1 1/2 in. lap and set line-and-line on the exhaust edges or, alternatively, try not more than 1/16 in. exhaust clearance. This might give the results required. In any case, with about 10 or 12 per cent clearance, not less than 30 per cent compression (i.e., closure at 70 per cent) will be wanted at 25 per cent cut-off and the exhaust clearance can be adjusted to get this result.

Adding to the lap will, of course, shorten the full-gear cut-off, but that will be an advantage, for one reason, because it will allow of a proper exhausting of the steam in full gear with the proposed reduced exhaust clearance. At present the release is too early when running at short cut-offs, but the excessive exhaust clearance is required in order to get the steam out of the cylinders with the long cut-off in full gear.

K. B. G. should refer to the *Railway Mechanical Engineer* for January, February and March, 1933, for remarks on lead variation in the Walschaert motion. There are two or three methods of accomplishing this and all have been described in your paper. Variable and increasing lead as the cut-off is reduced is an advantage, but the thing to do in the present case is to get more lap on the valves and increase the compression, not reduce it. The engines will then run 20 per cent, but 25 per cent will be the best position for all-around good results.

E. CECIL POULTNEY,
London, England.

* See the *Railway Mechanical Engineer*, November, 1934, page 405.

Large Heating Surfaces

To THE EDITOR:

On your Gleanings page a correspondent brings up the question of large heating surfaces in the boilers of 4-8-4 type locomotives. On referring to page 45 of your February, 1936, number, I note that the Chesapeake & Ohio Class J-3 locomotives are said to have the "largest combined heating surface of any locomotive of this type thus far built; namely, 7,880 sq. ft." Your correspondent also believes that the C. M. St. P. & P. Class S-1 locomotive, with 7,803 sq. ft., should occupy second place.

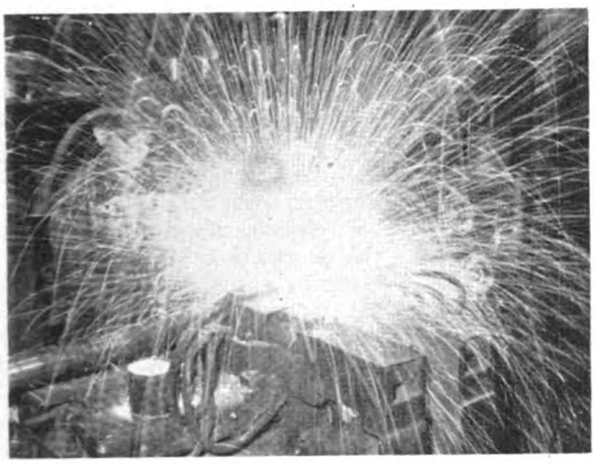
In making these statements, two other locomotives seem to have been overlooked. The A. T. & S. F. locomotives of Class 3751, which were described in your July, 1928, number, have a combined heating surface of 8,098 sq. ft., and in the Great Northern Class S-1 engines, this figure reaches 7,849 sq. ft. Because of the difficulty of keeping track of these "records," I would not claim that the Santa Fe engines should head the list, as the next number of the *Railway Mechanical Engineer* might possibly describe something even more imposing.

While on the subject, it might be of interest to mention that the Class T-2, 4-8-2 type locomotive, built for the Baltimore & Ohio in 1931, has a combined heating surface of 7,957 sq. ft., though it weighs nearly 50,000 lb. less than the lightest of the engines previously mentioned.

It is hardly necessary to add that too much importance should not be attached to differences of one or two hundred square feet of total heating surface in these large boilers, since many other factors must be considered before any intelligent prediction and comparison of their performance can be made.

WILLIAM T. HOECKER.

IN THE BACK SHOP AND ENGINEHOUSE

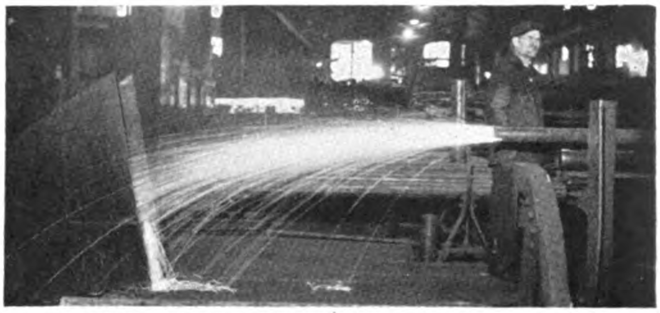


During the flash period air is blasted through the flue.

Safe Ending Flues Improved by Air Blast

The troublesome ridge on the inside circumference of boiler flues and tubes, formed by rolling-in the slag from the resistance butt welds of safe-ended flues when working the hot weld over a mandrel between a set of rolls, has been eliminated successfully at the West Albany shops of the New York Central System by the simple expedient of blowing the slag from the resistance weld by a blast of air during the flash period. Prior to incorporating the air-blast innovation with the resistance welder, the rolling-in of the slag on superheater flues formed a ridge approximately 3/8 in. long and 3/32 in. high, thereby reducing the inside diameter of the flue at the weld by about 3/16 in. This reduction in diameter was found objectionable because the bands on superheater units caught on the ridge when the units were applied and because it restricted the flow of hot gases, increased the scoring effect of cinders, and afforded a starting point for the honeycombing of cinders. One of the illustrations shows the effectiveness of this air blast in eliminating the ridge; the view showing the ridge formed by rolling-in the slag was taken of a flue which had been in service several years.

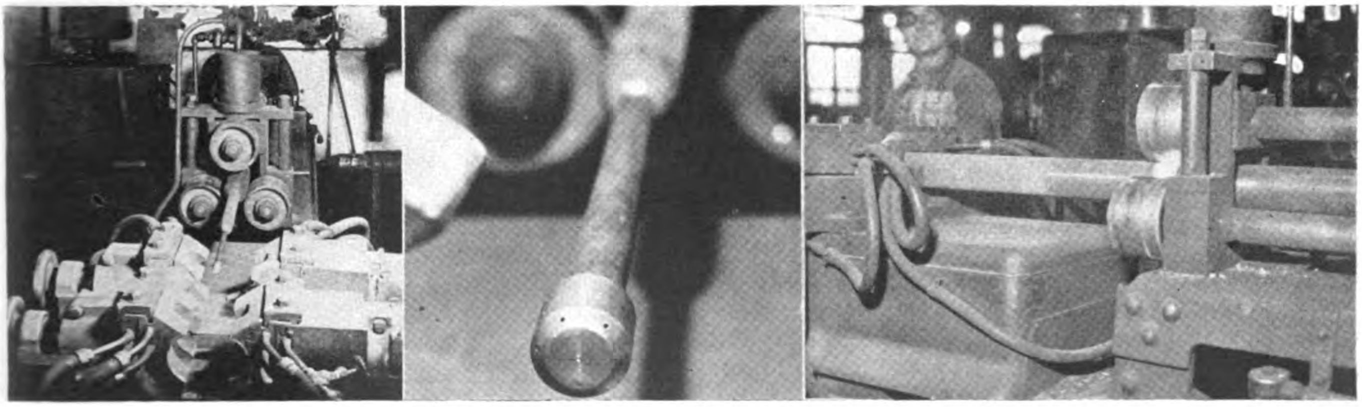
When welding safe ends to old flues at the West Albany shops, the safe end and one end of the flue are held in water-cooled copper electrodes, and as the two are forced together, a heavy a.c. current is passed between them. During the flash period which occurs when the two ends are brought together, air is blasted through the tube under manual control of a foot valve. When the flash is over the air is shut off and two ends are brought up to a welding heat. As soon as sufficient heat has been applied, the flue is moved forward over a mandrel and between a set of rolls where the hot weld is worked and reduced in section. The blast of air furnished during the flash period comes from a short piece of 3/8-in. pipe threaded into a hole in the end of the mandrel and terminated with a nozzle in which there are six small holes. Air pressure at 80 lb. per sq. in. is applied to the inside of the mandrel during the flash period, and the air is ejected through the holes in the nozzle, the holes being so drilled that the air is forced outward at an angle of 30 deg. with the horizontal, thereby imparting a spiral or rotating motion to the air as it passes through the flue. The hot slag at the inner surface of the weld is carreid away and blown out of the end of the flue into a receptacle placed to receive it. When the weld is rolled, there is very little slag inclusion and therefore no ridge formation or de-



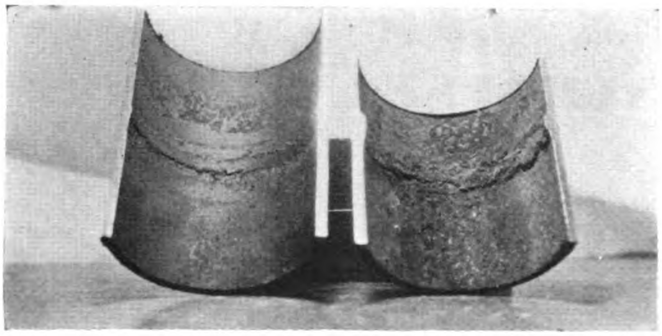
Slag being blown from the flue during the flash period

crease of flue diameter. The quality of the weld is also improved.

When flues have reached the limit of safe ends which can be applied, it is general practice on the New York Central to cut off all the welds, weld on a length of second-hand flue, and then apply a 6-in. safe end of new material. At the next shopping the 6-in. end is cut



Left: The welding electrodes and rolls—The air nozzle can be seen extending from the mandrel—Center: The air nozzle—Right: The welded flue is pushed forward over the mandrel and rolled



Left: Superheater flue rolled after slag has been blown from the safe-end weld—Right: A flue with slag inclusions rolled into the weld which reduced the inside flue diameter 3/16 in.

off and an 8-in. safe end is applied. At the third shopping the 8-in. end is cut off and a 10-in. safe end is applied. At the fourth shopping the 10-in. end is cut off and 12-in. safe end is applied; the 12-in. safe end is the maximum length of new material used. At the fifth shopping an 18-in. length is cut from the flues, and a 12-in. length of second-hand flue plus a 6-in. safe end are welded to the flue to restore it to its required length. This procedure is followed indefinitely. If a flue is pitted, the pitted portion is cut off and a section of second-hand flue plus a 6-in. safe end are applied to restore the flue to its required length. The mandrel over which the flues are rolled is 10 ft. long to accommodate long pieces of second-hand flues which must be applied when reclaiming flues.

There is one resistance welder for superheater flues and one for tubes in the West Albany shops with nominal ratings of 165 to 150 kv.a., respectively. They operate from a 440-volt 60-cycle circuit. All welding is done on the second trick for the purpose of reducing the peak load on the power plant.

Electric Furnace Used In Sedalia Spring Shop

One of the most modern applications of electric furnaces to railroad repair work is the installation in the spring shop in the Sedalia, Mo., shops of the Missouri Pacific. The electric furnace, used for heating springs of both the coil and bar type, was installed in December, 1935, and is of the bell-car type. In other words, a bell housing, operated up and down hydraulically, is placed over a specially constructed car carrying a basket containing the load of springs to be treated.

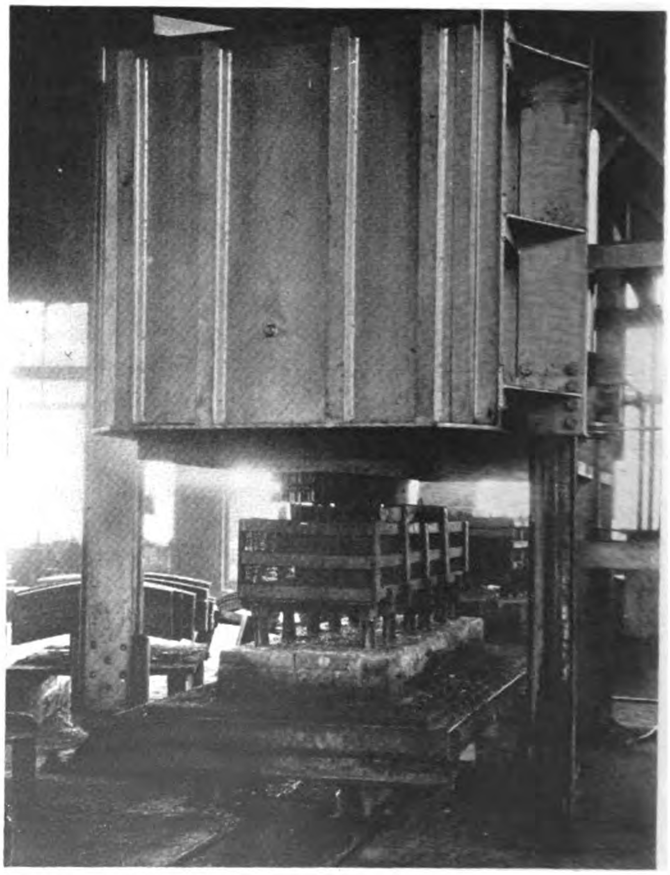
This furnace was designed and built by the General Electric Company. The overall dimensions of the bell are: Length, 8 ft., width, 4½ ft., and height, 7 ft. With the bell raised, the height above floor level is 12 ft. The inside dimensions are: Length, 72 in., width, 28 in., and height, 28 in. The shell of the bell is of steel, with 9 in. of silocell insulation, and semi-refractory brick lining. Heating units, of the nickel-chromium ribbon-resistive type, are mounted inside on the side walls and ends of the bell. An alloy-metal baffle is mounted inside the bell in front of the heating units. Two turbo-type blowers, 18 in. in diameter, are mounted in the top of the bell. These draw air up from the load, through openings in the top baffle, and distribute it behind the side and end baffles, over the heating units, and back to the base of the shell, where it is distributed through the load and drawn back up again.

Two narrow-gage cars are used in conjunction with the bell. When lowered over the car, the furnace rests in a sand seal, an angle iron on the furnace fitting into a sand filled channel on the car. A hearth is provided on each car, the load being supported on pedestals 7½ in. above the hearth.

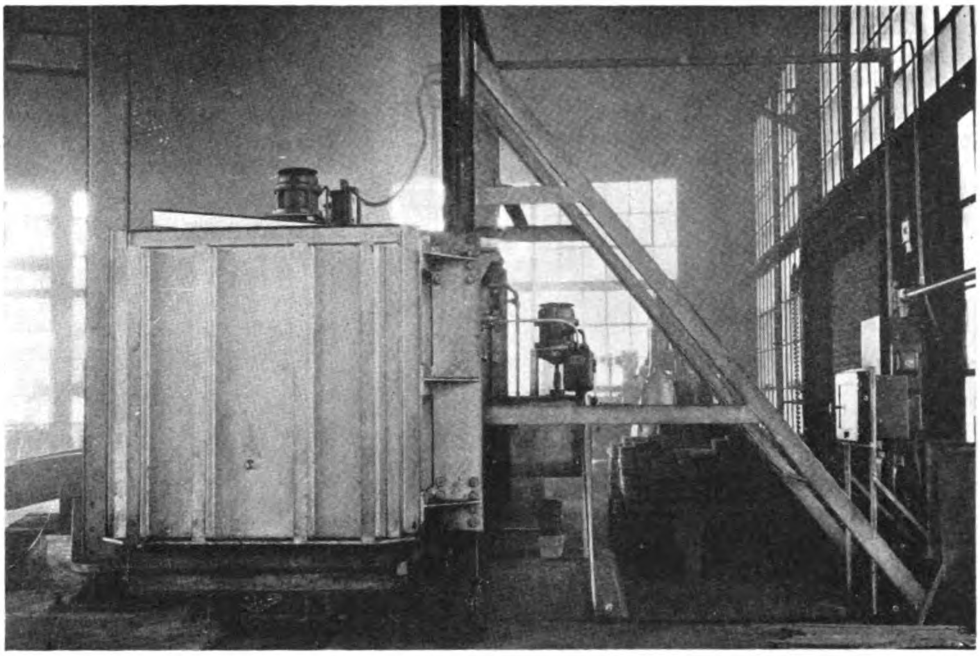
Springs to be tempered are placed in specially constructed baskets approximately 72 in. by 22 in. by 20 in., made of 3/16-in. by ¾-in. wire-mesh screen mounted on a frame of ½-in. by 2-in. steel. A basket is placed on one of the cars by a 3-ton pneumatic jib crane located adjacent to the furnace, and then the car is pushed into place under the bell of the furnace. In order to place the car accurately, a bar lock is provided, fitting into an alining clamp attached to the framework supporting the bell. The bell is then lowered over the basket of springs by operation of a valve releasing the oil from the hydraulic lift back into the oil reservoir.

As the furnace heats up to a predetermined temperature, which may be any temperature up to 1,200 deg. F., the temperature is recorded continuously by a Leeds & Northrup recording instrument which, when the desired temperature is reached, cuts out the heating elements. Subsequently, the Leeds & Northrup instrument cuts the heating elements back in if the temperature drops more than 10 deg. below the predetermined desired value. Thus, the temperature in the furnace, which incidentally is maintained exceptionally uniform throughout the interior by the use of two blowers mounted on the top of the furnace and operated by two 3-hp. General Electric induction motors, is maintained within 10 deg. of the predetermined value. The temperature control is provided by a thermocouple inserted approximately 8 in. below the top of the furnace, and extending approximately 3 in. into the interior.

The bell is raised and lowered by operating a magnetic switch which controls the operation of a centrifugal



The electric furnace with bell raised showing load in place for heat treatment



The electric furnace with bell lowered in position on one of the cars. The blower motors can be seen at the top of the bell, while the hydraulic pump and its motor are shown to the right in the triangular structure

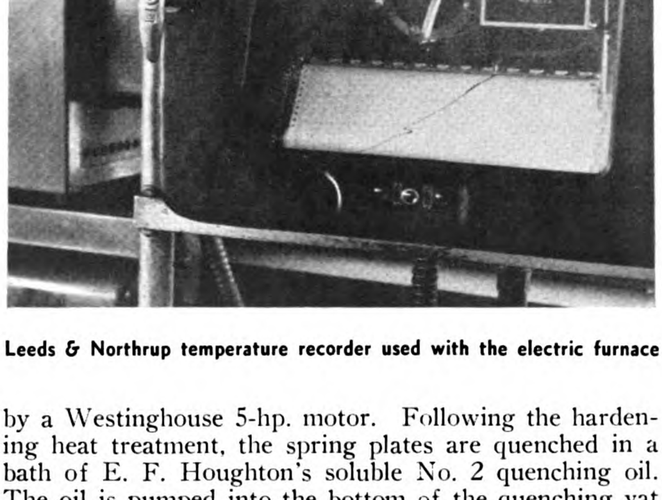
pump for pumping oil into a hydraulic lift. When the bell rises a limit switch cuts out the heating elements and stops the blower motors. A limit switch stops the bell when it reaches its maximum height. When the bell is lowered to a closed position, by releasing oil from the hydraulic lift, the limit switches to the heating elements and blowers are closed but are not energized until a magnetic push button is operated.

Among the advantages obtained from the use of the furnace are: Those arising from uniform furnace temperature, with only 10 degrees variation above or below that desired; improved quality, particularly where alloy steels are used, as is more common at the present time; and a saving of $615 per month on labor, fuel oil and material by substituting the electric furnace for an oil-fired furnace. The furnace uses 70 kw. per hr., at which rate the cost of operation is $3.15 per day or $69.30 a month, based on an average power cost of 1c per kw.-hr. and an average operating period of 4½ hrs. per day and 22 days per month.

Procedure in Treating Springs

The method of handling and processing springs is interesting in that material entering the shop at the east end follows through the shop from one operation to another, progressively, so that it emerges at the west end complete and ready for service. The spring shop is approximately 75 ft. wide by 150 ft. long. The storehouse for spring steel is just outside the east end of the spring shop. Steel for bar springs is taken from the storehouse through one of the spring-shop windows, and is cut into correct lengths, according to the class of spring desired, on a punch and shear machine driven by a Westinghouse 5-hp. motor. Some of the plates are punched, as necessary. The steel plates then go to an oil-fired center heater furnace, equipped with blowers driven by 3-hp. motors. Here the steel is heated to about 1,700 deg. F. preparatory to going to a "nibber," driven by a Westinghouse 5-hp. induction motor. The steel is again heated, in another oil-fired "forming furnace" equipped with a blower driven by a 7.5-hp. motor. In this furnace the steel is heated to approximately 1,800 deg. F., the temperature being controlled on this furnace by Leeds & Northrup thermocouple control equipment, without recording instruments.

After forming is completed in a pneumatically operated "former," the steel is air-cooled, after which it is placed in a rotary furnace, with an 11-ft. bed plate and an operating cycle of 40 min., for hardening. Carbon steel is heated to 1,525 deg. F. while alloy steel (silicon-manganese) is heated to 1,625 deg. F., for one cycle of 40 min. A Leeds & Northrup automatic temperature control, including a recorder, is used on this furnace. The furnace table is turned by a Westinghouse 3-hp. motor, chain connected; the cycle can be adjusted from 7 min. to 40 min. A blower on this furnace is operated

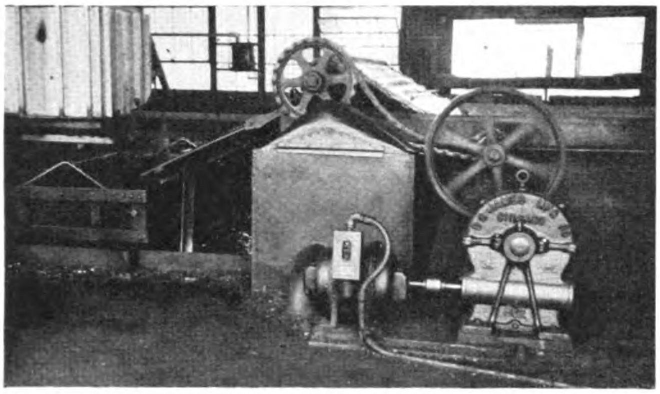


Leeds & Northrup temperature recorder used with the electric furnace

by a Westinghouse 5-hp. motor. Following the hardening heat treatment, the spring plates are quenched in a bath of E. F. Houghton's soluble No. 2 quenching oil. The oil is pumped into the bottom of the quenching vat at the bottom and runs out a weir at the other end at the top at the rate of 300 gal. per min., being pumped into the vat by a centrifugal pump operated by a General Electric 3-hp. induction motor. To keep the oil cool, it is conducted through a water-cooled cooler, by a centrif-

ugal pump which is started by a thermostat when the temperature of the oil goes above 140 deg. F.

As the spring plates are dumped into the oil vat they fall on a conveyor rack of the steel-chain type operated by a 2-hp. motor. The plates are in the quenching oil



Quenching vats with motor-driven air pump

for 3½ min. Following the quenching bath, the plates are placed in the baskets for temper treatment in the electric drawing furnace described previously. Carbon steel is drawn to 725 deg. F., while alloy steel is drawn to 925 deg. F., for 1 hr. 15 min. After this, the plates are air-cooled, and assembled ready for banding. An oil-fired band heating furnace is provided, equipped with a blower driven by a 2-hp. motor. The bands are heated to 1,800 deg. F. Hydraulic banders, exerting 1,500 lb. per sq. in. pressure are located adjacent to the doorway at the west end of the building. The pump supplying pressure for the banders is driven by a 20-hp. motor.

Coil springs are heated to 1,625 deg. F. for 40 min. in a separate rotary furnace on the north side of the building equipped with Leeds & Northrup temperature control equipment. The table and blower of this furnace are driven by 5-hp. motors. After being heated, the coils are placed in a coil former which is pneumatically operated, after which they are taken to a separate quenching vat, similar to the one described previously, and placed in the oil for 4 min. with the oil to 140 deg. F. or less. Both the coil-spring and leaf-spring vats are fed from the same source. Following this treatment the coil springs go to the electric drawing furnace.

A Tinius-Olsen hydraulic beam-type testing machine, situated in the northwest corner of the shop is used for testing both coil and elliptic springs, about six springs being selected from each class of springs passing through the shop. In addition, all springs are tested on the hydraulic testing machine for load-carrying capacity, free and loaded height, and checked for any possible defects before leaving the shop.

Typical Engineered Cleaning Operations

*By H. Liggett Gray**

The study of cleaning materials and methods of a railroad maintenance problem was taken up as a definite engineering project more than a score of years ago. The first step, logically, was to separate the project into two divisions—chemical and mechanical. (1) The chemistry of the cleaning problem includes the types of oils, greases and foreign matter to be removed and what types of cleaning agents were most active on these in order to produce fast-working, safe, economical materials. (2) The mechanics of the cleaning problem involves the development and refinement of the most effective methods of applying the cleaning materials.

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Study By Types of Cleaning

Since cleaning operations differ so greatly, they have been classified and individual engineering study made of each type. For example, some cleaning operations are performed as a mechanical necessity in the operation of a railroad. Typical of these are cleaning locomotive mechanical parts for overhaul, periodical cleaning of air pumps and air-brake parts, and cleaning frames, driving

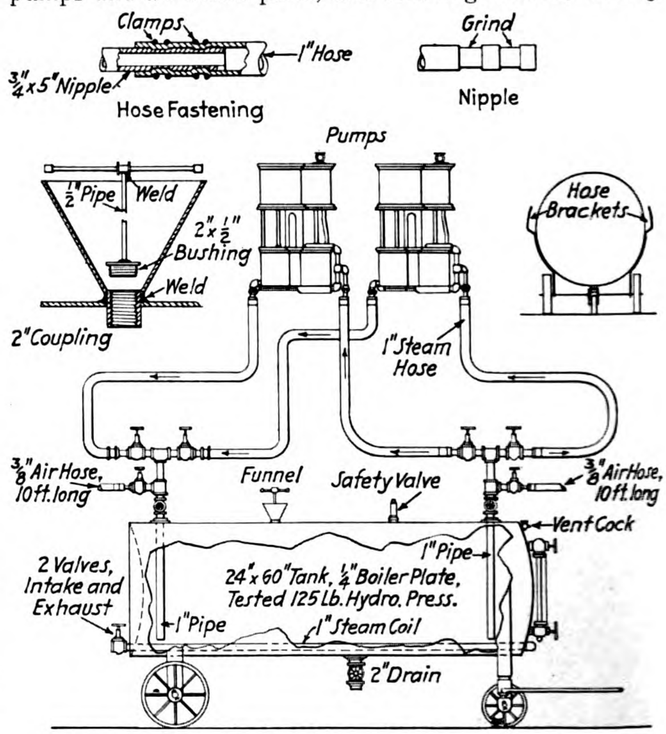


Fig. 1—Solid-flow circulation system for cleaning air cylinder, valves and ports of air pumps

rods and valve-gear parts preparatory to making fracture tests.

Other cleaning operations are done more for the sake of appearance or comfort. Typical of this classification of cleaning operations are the following: Cleaning of locomotive cabs and tenders, coaches and other cars, and the air filters and heating coils of air-conditioning systems.

Servicing of Air-Brake Equipment

The maintenance cleaning of braking equipment has necessarily kept pace with the constant improvement of the equipment itself. The parts which receive particular attention with respect to cleaning are air pumps, intercoolers, reservoirs, and triple valves.

In addition to cleaning the pumps, during shopping periods, it has been found advisable to adopt as standard practice the periodical cleaning of the air cylinders without removing the pumps from the locomotives. This keeps the valves, piston rings and ports free from gummy or partly carbonized lubricating oil. There are two very simple methods recommended for this work. One method circulates a solid flow of cleaning solution through the air cylinders; the second method, sometimes referred to as the "vapor system," permits the

pump to circulate a froth of bubbles of high cleaning ability.

Fig. 1 illustrates a simple arrangement of portable equipment required for the system employing solid-flow circulation. Such equipment is easily assembled in any railroad shop. The engineering details, however, as to connections, sizes of piping, etc., will be most effective if checked by a cleaning service man familiar with that work. In any event, it is essential to supply a tank with a safety valve, hoses, and connections, all designed for high pressure. The material, as well as the equipment, should be carefully selected not only so that it will remove the heavy oils but so that it will be safe for the men to handle, avoiding the danger to eyes and skin which are present in the use of caustic or lye. Cleaning the air pump with this equipment takes about one hour, including the time to make the necessary connections.

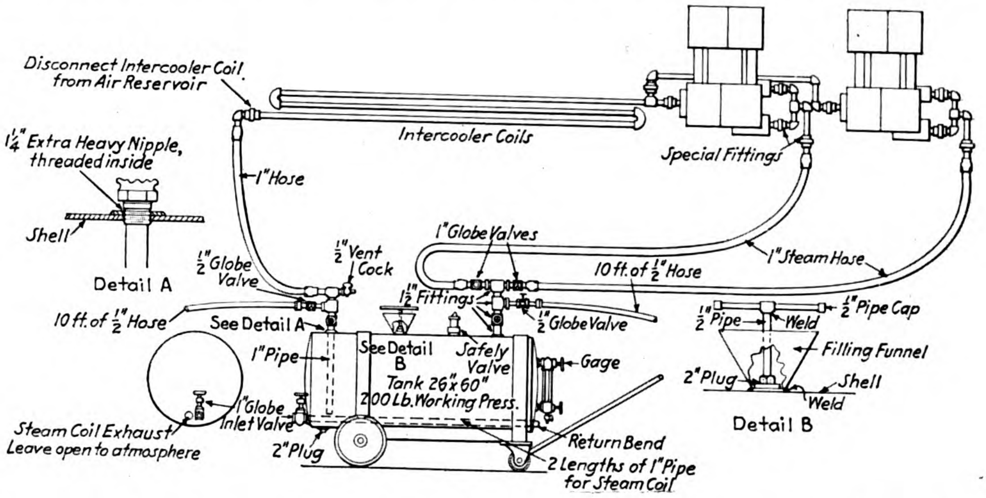


Fig. 2—System for circulating frothy cleaning vapor adaptable to cleaning air pumps, intercoolers and reservoirs

Fig. 2 illustrates a vapor system for cleaning air pumps which is fully as effective as the solid-flow system and has the added advantage that it can be applied at the same time to cleaning intercooler coils and, if necessary, air reservoirs. It has been found that inevitably a small quantity of excess oil occasionally is carried into the intercooler coils and even into the air reservoirs. Accumulations of such oil are dangerous for they can, under certain conditions, produce an explosive vapor causing a rupture of the air reservoir. Therefore, some railroads have found it advisable to apply this vapor system, with the circulation cleaning out the intercooler coils, as well as the air cylinders of the air pumps. This equipment is easily assembled at small expense from materials already available in practically any railroad shop, but it still is advisable that a cleaning service man cooperate in the initial installations to assist in obtaining the quick and thorough cleaning results which this material and method can produce.

Triple valves, distributing valves and other equipment auxiliary to the air-brake system can be cleaned in a tank of heavy-duty cleaning solution, heated by steam. It is generally recognized that this procedure saves labor in disassembling such equipment while making repairs and gives assurance of clean air passages.

Heavy braking caused by dirty brake equipment brings the train to an abrupt, uncomfortable stop and sometimes results in slid-flat wheels. As an illustration of the economy of modern cleaning methods, one railroad division which had thirty-five flat driver wheels during a two-year period before adopting modern cleaning materials and methods for air-brake maintenance had but one slid-flat driver in two years following the adoption of an engineered cleaning program.

Steam Cleaning Locomotive Gear

An example of another classification of cleaning work for railroads is the application of steam cleaning. This does not refer to the use of live-steam alone which, while it will knock off large pieces of dirt, will not remove grease and oil, particularly on parts which have been subjected to heat. Furthermore, such an operation is expensive since it will require more steam than a properly designed steam cleaning installation.

Several methods have been developed for combining a flow of heavy-duty cleaning solution and water, propelled by steam. These are not very complicated to install but the details have required much engineering work in order to proportion the various parts of the system properly so that they will operate with greater cleaning effect and at less cost than makeshift equipment.

Typical uses of such an installation are: (1) Service cleaning of locomotive running gear, (2) cleaning locomotive and car truck parts in the shops before overhaul, and (3) cleaning driving rods, cross heads, valve gear and frames before applying whitewash for fracture tests.

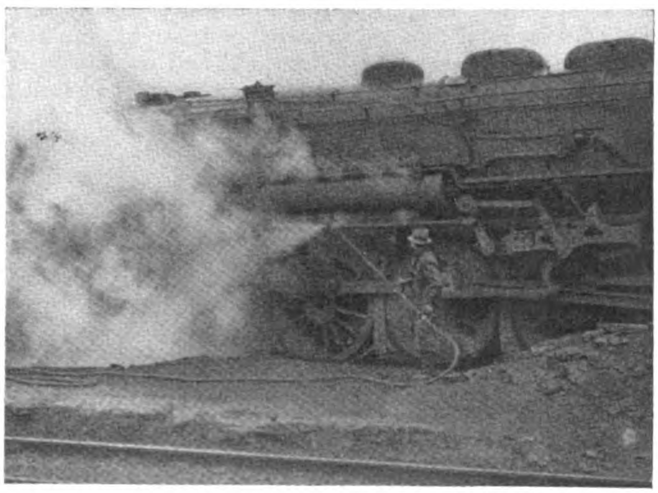


Fig. 3—Cleaning a locomotive with heavy-duty cleaning solution and water propelled by steam

Fig. 3 shows a typical installation in use for service cleaning of locomotives. The success of such cleaning depends both upon the cleaning material used and the mechanical arrangement of the installation. It can be assembled from parts generally found in the railroad

shop. The design of the actual steam gun which the operator handles has been thoroughly studied and is a more important item than might be realized. Fig. 4 shows an effective type of gun. Makeshift guns are likely to discharge alternate slugs of solution and steam or be so heavy or improperly balanced that the operator tires easily and does poor work. With a proper steam

Fig. 4—Properly balanced and heat-insulated gun for cleaning locomotive parts

gun and effective cleaning materials, one man can do more thorough cleaning of a locomotive frame in shorter time than several men, using a steam jet, scrapers and brushes, or other inadequate methods. Proper cleaning is of particular importance in preparing for fracture tests since whitewash applied to parts on which there remains even a small film of oil or other foreign matter, will sometimes prevent cracks in the metal from showing up.

Other Modern Cleaning Problems

The modernization and changing character of motive power and rolling stock has brought additional cleaning problems for which it has been necessary to develop special materials and methods. For example, any appreciable accumulation of deposits and foreign matter which gather in the cylinder jackets and radiators of internal-combustion engines is likely to cause over-heating at heavy loads. It has been necessary to develop materials which will remove the bulk of the scale and deposits in these cooling systems, at the same time providing for safety from attack to the cast-iron water jackets, gaskets, rubber hose, pump packings and various metals in the radiators. Such a material, properly applied, maintains an internal-combustion engine in good condition and saves a great amount of labor when compared to removing the deposits by hand. It also reaches and cleans out deposits in pockets which are almost impossible to reach when scraping out by hand.

A different class of cleaning problem has been encountered since the introduction of air-conditioning. The air filters must be cleaned at regular intervals so as to provide full capacity for the flow of air while retaining the ability to filter the impurities out of the air.

An additional cleaning problem is the maintenance of the bright-colored finishes which are used on a number of the modern high-speed trains. Even for such work, cleaning materials have been developed which will maintain the bright color and gloss of the paints without injury.

Safety, as well as economy, results from a well worked out cleaning program based upon experience. Such programs naturally differ widely with different railroads. Therefore, the schedule must be flexible until an experience record has indicated just what intervals of cleaning fit the particular situation. Almost every railroad differs from all others as to types and amounts of equipment, shop and yard facilities and types of foreign matter to be removed.

However, the handling of the problems in all instances is fundamentally the same, in that (1) materials and methods should be applied that are the most effective for each individual cleaning operation and (2) a time schedule should be set so that the cleaning operations can be carried out at the definite intervals which experience indicates are the most suitable.

The result of establishing such a program promotes safety to train personnel and traveling public from properly cleaned mechanical parts, permitting proper inspection and repair; safety to railroad shop personnel from use of safe cleaning materials and methods; safety to locomotives, rolling stock, and other equipment cleaned by materials non-injurious to the metals and parts, and prevention of accidents, mechanical failures and breakdowns by proper cleaning of mechanical parts, permitting effective inspection.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Soft and Hard Boiler Patches

Q.—Please explain the meaning of a soft patch and a hard patch on a boiler?—T. K.

A.—A soft patch is a patch put together by bolts or screw studs and usually is of a somewhat temporary nature. A hard patch is a patch secured by riveting and is a permanent repair.

Function of The Injector

Q.—An injector is feeding a boiler at 100 lb. per sq. in. steam pressure. Describe its action fully.—G. G.

A.—An injector forces water into the boiler because the kinetic energy of a jet of steam is much greater than that of a jet of water escaping under the same conditions.

A simple illustration of an elementary steam injector is shown in Fig. 1. Steam at 100 lb. per sq. in. pressure is admitted through the steam supply *A*, flows through the steam jet *C* and combining tube *D* and passes through overflow *G*. The action of the steam jet through *C* creates a vacuum in the feedwater inlet *B*. The vacuum created in the feedwater *B* draws in the water which, meeting the steam in the combining tube *D*, condenses the jet of steam. The steam issues from the overflow *G* as a jet of water, rapidly increasing in velocity, which builds up pressure against the boiler check *H*. The continued increase in velocity of the jet causes pressure against the boiler check to exceed the

boiler pressure of 100 lb. per sq. in. and the latter begins to open, part of the water entering the boiler and part flowing out through the overflow *G* until the velocity in the combining tube *D* has become so great that all resistance is overcome and the check valve *H* is forced wide open, all the water entering the boiler. The action of the jet passing from the combining tube *D* to the delivery tube *E* now creates a vacuum in the overflow, which causes the overflow to cease, closing the overflow tube, thus shutting out the air which would otherwise be forced into the boiler.

Stress Relieving in Boiler Welding

Q.—What is meant by stress relieving?—A. P.

A.—Stress relieving is the act of relieving the stresses set up in the metal of an object due to the expansion and contraction while being welded.

Fusion welding of boiler plate causes a high temperature to be applied locally in the sheet at the point of the weld. The molten metal of the weld is surrounded by the relatively cold mass of metal in the rest of the sheet. The consequent expansion and contraction result in the possibility of setting up more or less severe stresses in the weld or in the metal adjacent to it. Such stresses are referred to as "locked-up stresses." There is no question whatsoever that such stresses do exist. How severe they may be and what their distribution is have not been positively determined, but in many cases, and particularly in vessels of heavy plate thickness, steps must be taken to relieve such stresses if the vessel is to be safe for use.

Working Nickel Steel

Q.—Our railroad recently purchased some locomotives which use nickel steel in the boiler construction. I have read numerous articles but have not come across anything that gave me any information as to the proper method of working this particular steel.

I would like some information in regard to heating this metal, as in applying a patch, etc. The general opinion seems to be, to keep heat away from this metal as when fitting up a patch and getting it ready for riveting.—R. M.

A.—There is no objection to heating nickel steel, provided it is done properly. It is advisable in heating nickel steel, preparatory to working, that the temperature range from 500 degrees to 700 degrees F. be avoided. Uniform application of heat until the plate is cherry red should produce satisfactory results in forming the patch. When cooler or in the 500-degree to 700-degree F. range, the steel is "blue brittle" and difficulty through damaged plates may be encountered if it is worked in this range.

When local heating is necessary, it should be done over the largest area possible and the use of drift pins should be reduced to a minimum. In all laying up, a large area flatter should be used so that no markings whatever are made in the sheet, or, to be more exact, the sheet surface should not be fiber stressed or cut in sections by the marking of a hammer. In rolling high tensile alloy steel, more time is required, due to the toughness of the metal and the application of pressure on the rolls should be placed on minimum sections at more frequent intervals. Where nickel steels are used, the service demands are exacting and are such that exceptional strength and ductility are required. For this reason, patching is to be regarded as a doubtful practice unless it is done by competent men under proper supervision.

The bulletin on "Nickel Alloy Steels in Railroad Locomotives" discusses the effect of heating and cold working on nickel steel. This bulletin can be obtained from the International Nickel Company, Inc., New York.

Plugs Used To Secure Tight Seams

Q.—What is the purpose of the ⅞-in. plug on the longitudinal center line of a locomtive boiler seam, located between the outside welt and the adjacent shell course?—C. B.

A.—The purpose of the ⅞-in. plug between the outside butt strap and the shell course is to secure a tight seam.

The joint of the shell course to which the seam is attached is located on the longitudinal center line of the seam. Owing to the fact that the edges of the inside welt strap are not calked, the tightness of the seam is dependent upon the calking of the outside butt strap. The calking of the outside butt strap causes the seam to be tight at all points except the short space between the end of the butt strap and the shell plate of the adjacent course. This space is provided between the end of the outside butt strap and the adjacent shell course to allow room for calking both the end of the butt strap and the adjacent shell course.

In order to secure a tight seam, a screwed plug is inserted between the end of the outside butt strap and the adjacent shell course. The diameter of the plug must be large enough to fill this gap. The threaded plug produces a tight seam at this point.

Quantity of Water Discharged Through Blow-Down Valve

Q.—(1). Given a locomotive boiler under 200 lb. per sq. in. steam pressure, what quantity of hot water in pounds and gallons would be discharged to the atmosphere per second through a 2-in. straight blow-down valve?

(2). Can you give a simple formula for figuring similar problems under varying steam pressures? I find textbook formulas on steam flow and cold-water flow do not give correct results, and can find no tables on hot-water flow under pressure. —W. C.

A.—(1). The formula for computing the flow of water under pressure through an orifice is:

$$V = 0.98 \sqrt{2g\ (h + h_1)}$$

where:

V = velocity of flow in ft. per sec.
g = force of gravity in ft. per sec. Per sec. = 32.16
h = head in ft.
h_1 = head due to pressure = $\frac{P}{0.434}$
P = pressure in lb. per sq. in. 0.434 = lb. per sq. in. due to one foot of head.
0.98 = the coefficient of velocity.

The coefficient of velocity is empirical. Experiments indicate that it is approximately 0.98 and varies very little with the head.

The formula for quantity of flow is:

$$Q = 0.62\ AV$$

where:

Q = discharge in cu. ft. per sec.
A = area of orifice in sq. ft.
V = velocity of flow in ft. per sec.
0.62 = coefficient of contraction.

The coefficient of contraction is empirical. It is the relation of the area of the orifice to the area of the jet at a distance out from the opening about one-half its diameter and is taken about 0.62 of the orifice area.

The formula does not take into consideration the change in the head above the blow-off cock due to the

discharge. The effect of the change of head would be very small considering that the head due to pressure is so much greater than the head due to the height of the water in the boiler.

Assuming that the head due to the height of the water in the boiler above the blow-off cock is 6 ft. and substituting the values given in the question, we have:

$$V = 0.98\sqrt{2 \times 32.16\left(6 + \frac{200}{0.434}\right)}$$

$$= 0.98\sqrt{64.32\ (6 + 460)}$$
$$= 0.98\sqrt{64.32 \times 466}$$
$$= 0.98\sqrt{29{,}973.12}$$
$$= 0.98 \times 173.1$$
$$= 169.64 \text{ ft. per sec.}$$
$$Q = 0.62 \times \frac{3.142}{144} \times 169.64$$
$$Q = 2.294 \text{ cu. ft. per sec.}$$
$$1 \text{ cu. ft. water} = 7.481 \text{ gallons}$$
$$2.294 \times 7.481 = 17.16 \text{ gallons per sec.}$$

The weight of water varies with the temperature. The temperature varies with the pressure. From Marks and Davis steam tables, we find that at a pressure of 200 lb. per sq. in., the temperature of the water is 381.9 deg. F. Assuming that the temperature is uniform throughout the boiler and taking the weight of one cubic foot of water at a temperature of 381.9 deg. F., as 54.276 lb., the weight of the water discharged per second would be $2.294 \times 54.276 = 124.5$ lb. per sec.

Computing Back-Head Stays

Q.—Is it correct in computing the number of braces required to support a back head of a locomotive boiler to multiply the area to be stayed by the boiler pressure and divide by the allowable stress that can be carried by the diameter of the stay to be used?—R. H.

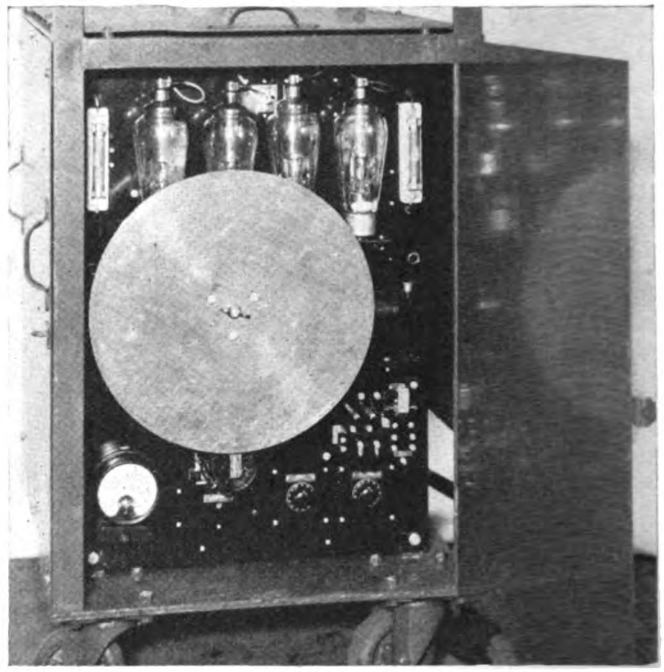
A.—The method outlined in the question would provide an ample number of stays to support the back head if the back head could be considered as a whole or it were possible to space the stays so that an equal distribution of the total load were placed on each stay. With the locomotive back head, this is practically impossible, due to the irregularity of the area to be stayed and the necessity of providing space for washout plugs and other appurtenances.

A better method would be to multiply the area to be stayed by the boiler pressure and divide the allowable stress per square inch for the type of stay used, thus obtaining the required cross-sectional area of all the stays. The area to be stayed should then be divided for any desirable spacing of the stays and the size or diameter of the individual stay should be based on the actual load that the individual stay is to carry due to the spacing. Precaution should be taken so as not to exceed the maximum allowable pitch of the stays for the thickness of the plate.

The total cross-sectional area of the stays used should be not less than the computed required cross-sectional area of all the stays.

Ignitron Seam Welder

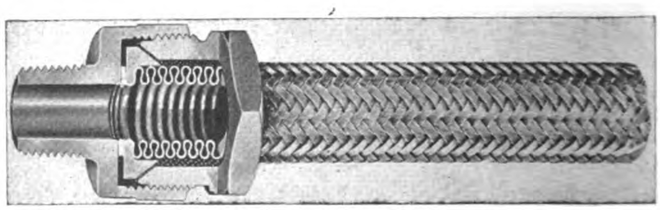
An ignitron seam-welder control utilizing ignitron tubes has been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. This control times the power impulses in terms of a definite number of power cycles to a wheel-type electrode resistance-welding machine. Among its features is an inductive timer consisting of a synchronous disc rotating once per second and containing 120 holes, each corresponding to a half cycle of welding current. Also, the use of ignitron tubes permits a design utilizing no voltages higher than line voltages and eliminating the need of power contactors and transformers. Steel pins are plugged into the holes according to the timing desired. The control is simple and durable, and the timing is precise. The use of this control is said to improve the quality of welds for light-gage steels. It is especially suitable for welding heavy-gage steels which demand heavy welding currents, and for welding special metal alloys such as aluminum and olympic bronze which demand accurate timing and often heavy current.



Inductive timer of Ignitron seam welder

Detachable Flexible Coupling

Simplicity is the feature of the illustrated heatproof detachable coupling for use with American seamless flexible tubing. Up to this time couplings that have been introduced have lost some of their value in the complexity of detaching and reattaching. The coupling is made in three parts—the end nut, split ring and top part, all of which are shown in the sectional illustration. Either males or unions are available. The coupling has no rustable parts, and since it can be detached and reattached without use of special tools or being returned to the manufacturer, it directly reduces maintenance costs of the use of flexible tubing. It is made by the American Metal Hose Branch, The American Brass Company, Waterbury, Conn.

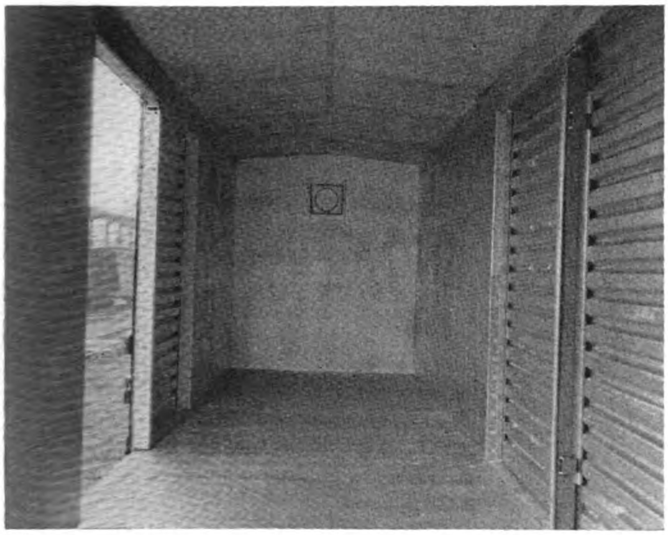


The American detachable flexible coupling

With the Car Foremen and Inspectors

Milwaukee Welded Automobile Cars

The Chicago, Milwaukee, St. Paul & Pacific completed building, a few months ago, a series of 1,000 automobile cars in its Milwaukee shops. These consisted of 500 50-ton cars, 51 ft. 7⅝ in. over striking castings and 500 40-ton cars, 41 ft. 7⅝ in. over striking castings. All-welded construction was employed in conjunction with high-tensile alloy steel, the production being 15 cars a day (50-ft.) and 18 cars a day (40-ft.), working three shifts. These cars, the largest of their type on the Milwaukee, have an inside height of 10 ft. 4 in. and an inside width of 9 ft. 2 in. They are featured by the use of Douglas fir plywood lining on the sides, ends and ceiling and the provision of staggered doors, 14 ft. 11 in. between posts for the 50-ton car, and an 18 in. by 16 in. lumber door at the *A* end of each car.

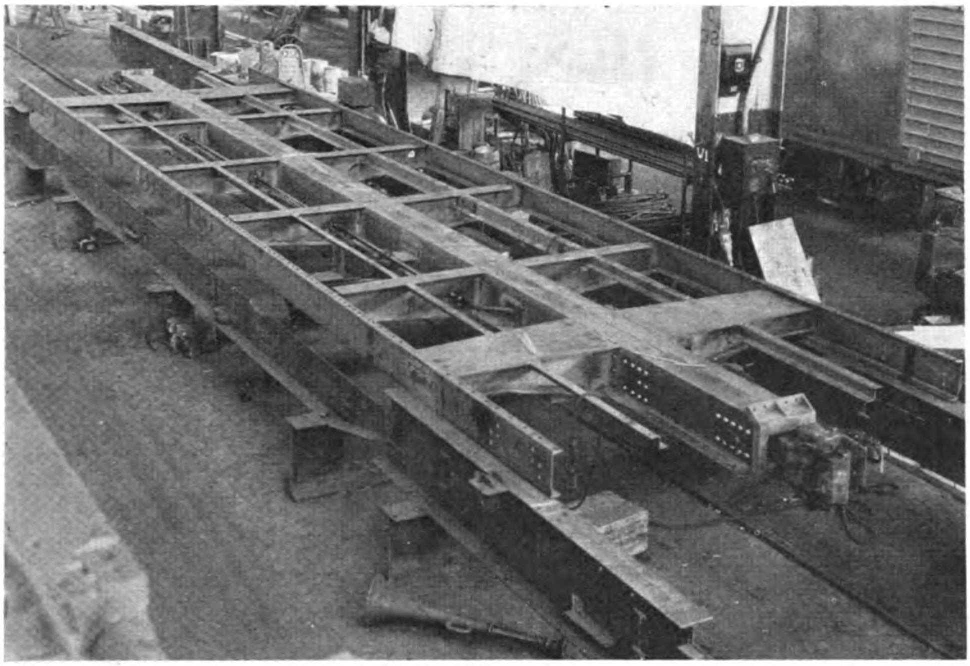


The entire inside of the car, including the roof, is lined with Douglas fir plywood

The cars were made on a production basis, employing the unit construction principle. Underframe, ends, sides and roof were assembled and welded completely as independent units, and subsequently united in their proper relation in an assembly line. These cars employ a combination of arc and resistance spot welding. The resistance spot welding is accomplished by using an automatic single-resistance spot welder, indirect-resistance spot welder and series-resistance spot welder. A single-resistance spot welder is one employing two electrodes, one positive and one negative. Usually one stationary electrode is below the work and one movable electrode to which pressure is applied is on the top side.

In series and indirect-resistance spot welders, the current passes through the work twice. The electrodes are arranged so that pressure is applied to both electrodes, pressing the work onto a copper backing. When proper pressure is built up, the current automatically is turned on and in the case of the series welder two spots occur where the electrodes contact the work. An indirect welder uses one electrode as a dummy; no spot develops at one electrode because of a large contacting surface

One of the Milwaukee all-welded automobile box cars as completed ready for service



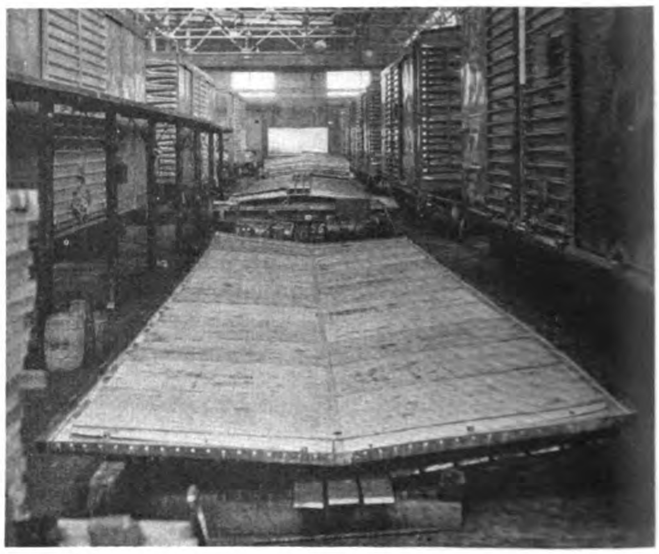
Frame welding position with underframe almost completely fabricated by welding

bringing the electrical resistance down below that required to heat the metal sufficient for welding.

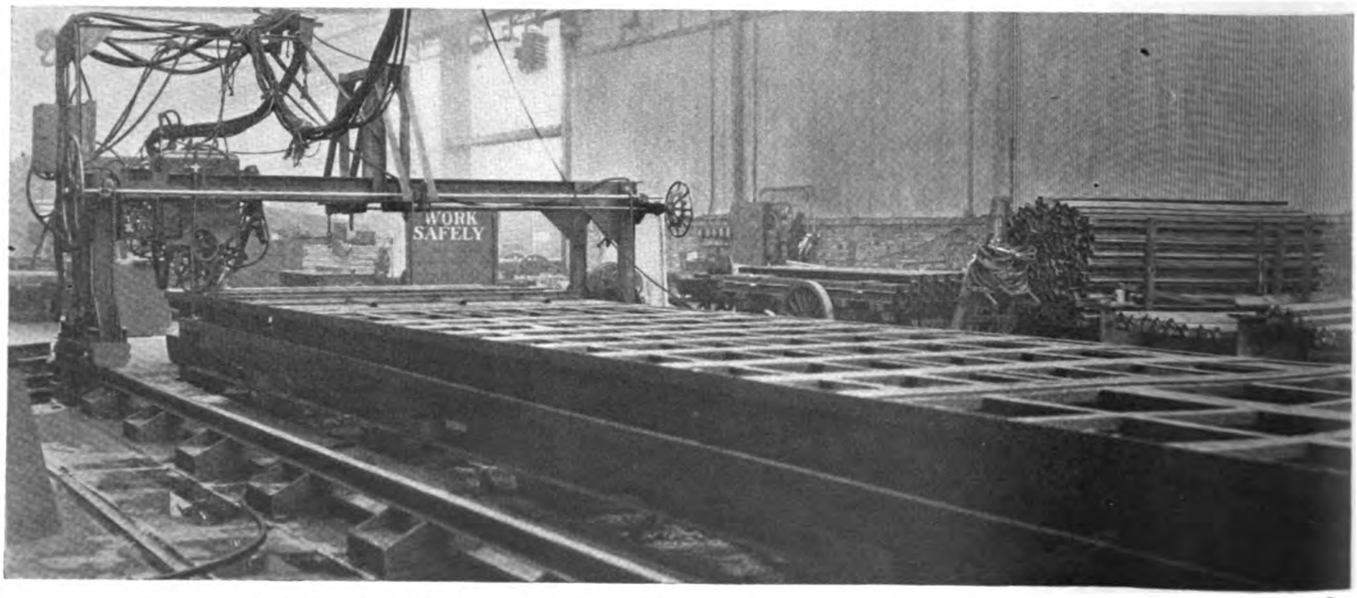
Sides

The first step in the production of sides is the series-resistance welding of the side-sheet stiffeners to the side sheets. These stiffeners are of 14-gage material, formed to a trough section 1½ in. deep and 2¾ in. wide, with 1-in. flanges on either side of the trough to provide surfaces for spot welding. These stiffeners are on 26-in. centers so that there are three rows of stiffeners running longitudinally on the side of the car. The sheets are all 9 ft. 7½ in. in height and 4 ft. 3⅞ in. to 4 ft. 11⅞ in. wide. The stiffeners are generally 2 ft. 3 in. long so that six stiffeners are required per sheet. A wooden templet is utilized in conjunction with special layout tables for the purpose of determining the position of and tacking stiffeners in place by arc welding. These parts are arranged in proper sequence and made ready for series welding.

The series welder is equipped with timing device which regulates the length of the time between spots, welding

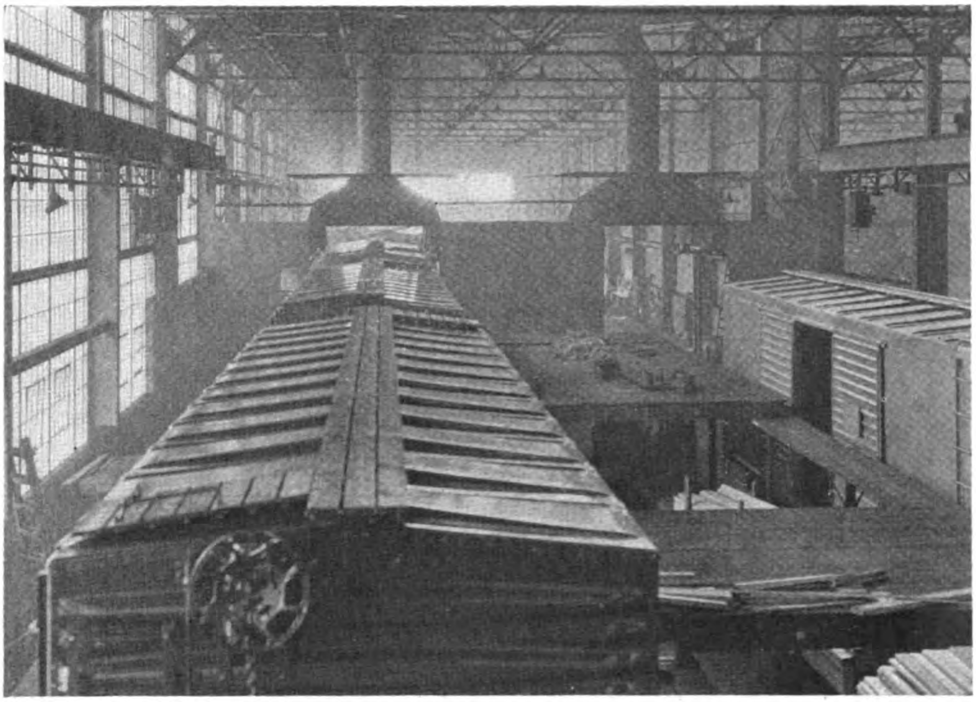


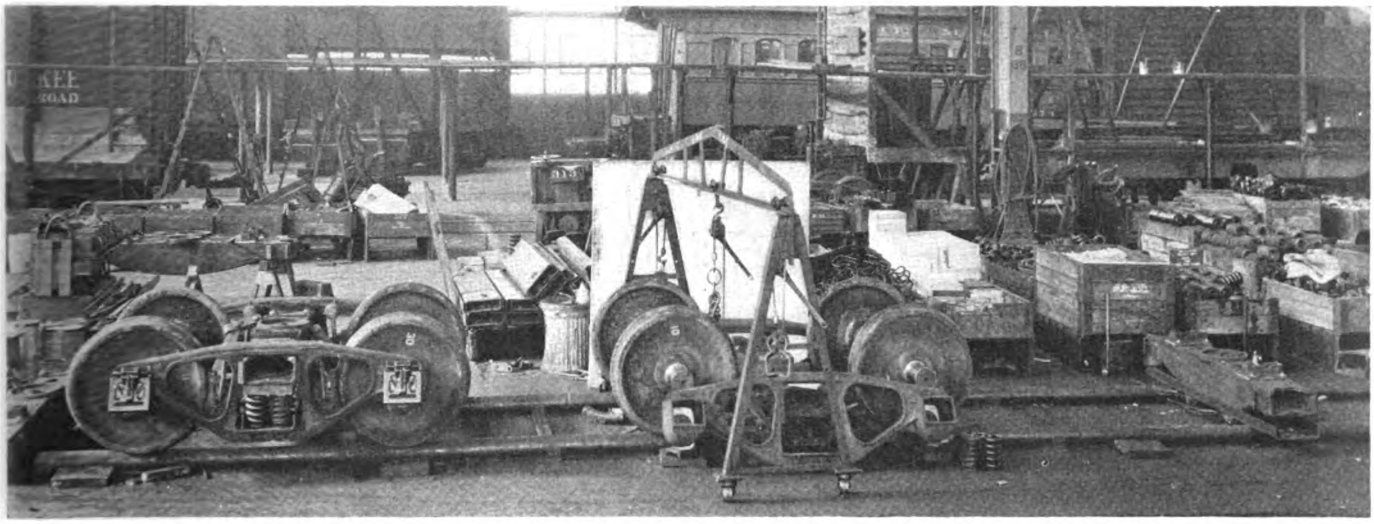
Car roof inverted for application of the Douglas fir plywood lining



Taylor-Winfield 440-volt, 133-kv.a. indirect welder applying side posts to side sheets by spot welding

DeVilbiss canopy-type spray hoods used in painting the cars





Truck position with one truck completed and another ready for assembly

time and pressure dwell. With this timing device it is possible to achieve a pace of 2.1 seconds per cycle or 1.05 seconds per spot including all handling time. While this operation is going on, sheets with stiffeners spot welded in place and side posts, which are formed Z-sections with 3-in. webs and with 2¼-in. flanges turned toward the inside of the car, are laid out in a side jig. The flange welded to the side is 1¾ in. for the ordinary post and for posts which form a backing for the joining of sheets, the flange is 2⅜ in. These are laid out and tacked to the sheets.

Under each post, an 8-in. copper bar, 10 ft. long, is embedded in the jig, completing the electrical circuit for an indirect resistance spot welder which welds the assembly together and completely welds as many posts as possible to the sheets with spots on 2-in. centers. When the series welder completes the cycle of applying stiffeners to side sheets the entire assembly, laid out and partially completed under the indirect welder, is moved forward and the balance of the spot welding required to complete the side assembly is accomplished in the series welder. The side sheets, completely spot-welded together, are moved along to a jig where the upper side-sill element, door post, side plate, corner gusset, etc., are placed and arc welded. The final side operation is to turn the entire assembly to another adjacent jig where all vertical and horizontal joints are arc welded with a continuous bead. In this same position the drip cap, upper door rail and doors are applied. This jig is long enough to accommodate two complete sides so that the side is moved on rollers to a second position where all scale resulting from welding is removed, employing a small high-speed air chisel.

Ends and Roofs

The Dreadnaught ends are formed in two halves which are spaced ⅛ in. apart in a jig and welded together. In this same jig, hand brakes and safety appliances are applied to the ends. The safety appliances are riveted in place in order to conform with the safety-appliance code which does not yet recognize welding as a proper method for applying these parts.

The roof is the patented Hutchins Car Roofing Company's product of pressed-pan construction. These pans are welded together in a jig for that purpose and, at the same time, the running board brackets and the running

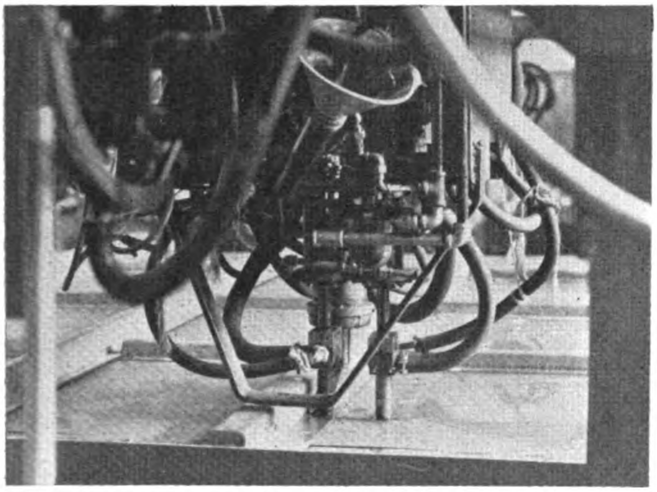
boards are welded in place. The roof is then turned over, red-leaded and the plywood ceiling applied so that it becomes a complete unit ready for erection.

Underframe

The underframe assembly commences with the bolster and crossbearer. Both of these items require two welding jigs, one merely for determining the position of the various parts and the tacking thereof, and second, a welding table. In the case of the bolster, which is heavier than the crossbearer, a revolving welding table in the form of a barbeque stand is used so that the welder can work in a most convenient position at all times. All outside welds of these items are of a continuous bead.

The center sills are made up of a combination of Z-sections 40 ft. 10⅛ in. long (for the 40-ton car), 12$\frac{3}{16}$ in. high, weighing 31.3 lb. per ft. These are welded together in a jig equipped to hold two center-sill assemblies at one time. They are welded on the inside with intermittent welds of 12 in. weld and 12 in. skip over the center half and the ends are welded with a continuous bead to the filler casting and between the filler and center casting. There is also a small amount of plug welding of the castings to the center sill. In this same position the center and filler castings are riveted to the center sill.

The center-sill assembly is moved to the next position where the bolster, crossbearer, floor stringers and side sill are completely welded in place, in an upside down position. The entire assembly is moved to another jig where the piping and air-brake parts are applied and the necessary brackets welded in place. In the next position the underframe is right side up and whatever welding is required in this position, such as on the center sill where the sills are welded continuously over the striking casting and bolster, is completed.



The electrodes in the welding head of the Taylor-Winfield machine

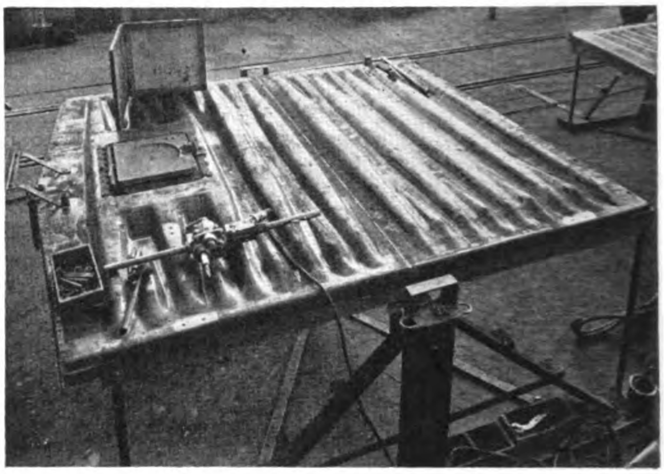
Assembly

The respective parts are now complete as units and ready to set the underframe on its trucks which are also pre-assembled. Sides, ends and roof respectively are applied in following positions and all welded together to form one component unit. All welds joining these parts are a continuous bead except that the roof is plug welded to the side plates and ends by means of $1\frac{1}{16}$-in. plugs on a 5¼-in. center.

The car structure being completely welded together, it is thoroughly cleaned, red leaded, two coats of mineral paint sprayed on, stencilled, the floor is laid and bolted in place, interior plywood finish is applied, interior sprayed with aluminum paint, and the car then inspected and released.

There are approximately 1,300 linear feet of arc welding and 3,860 spot welds required in the assembly of one 50-ft. automobile car. In the 40-ft. automobile car there are 1,060 linear feet of arc welding and 3,600 spot welds per car.

It is interesting to note that the weight of an average single-sheath automobile car is 56,400 lb. for a 50-ft. car and 46,000 lb. for a 40-ft. car, as compared with 47,400 lb. and 41,200 lb., respectively, for all-welded cars. This weight saving is accomplished entirely in the body construction as no saving of weight was effected in the trucks or in any of the specialties such as brakes, couplers, draft gears, etc.



Special jig used in welding two-piece steel ends, applying hand brake, etc.

Air-Conditioning Instruction Car

The Missouri Pacific recently equipped one of its coaches as an air-conditioning and electrical-equipment instruction car which visits various operating terminals for periods of one to four days. The car is in charge of a competent instructor and classes for maintenance forces and train crews are held at convenient hours to obtain the largest attendance.

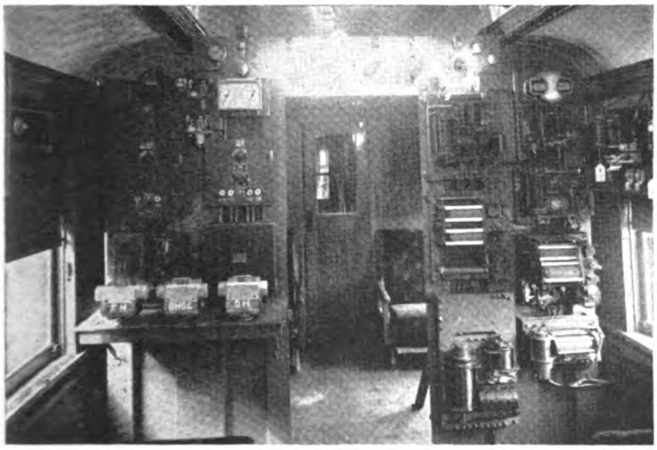
This instruction car was built and the course of instruction instituted because it was realized that the operation of car electrical equipment and air-conditioning apparatus is in the hands of the train crews who have had little or no electrical or mechanical training, and that the maintenance of the equipment is something relatively new to most of the maintenance forces. When there were but few air-conditioned cars in service it was possible to instruct train crews and maintenance forces individually, but this became impossible as the number of air-conditioned cars increased. Realizing that mechanics and train crews would have to be instructed along totally different lines, the car was divided into two sections, both of which are used for instructing maintenance forces but only one of which is used for instructing train crews.

The end of the car used for train-crew instruction is shown in one of the illustrations and contains exact duplicates of the control equipment used on Missouri Pacific steam-ejector, electro-mechanical and ice-acti-

vated air-conditioned cars. This end also contains working models of various types of automatic heating equipment in use on the Missouri Pacific. All of this equipment is completely wired, and by a simple switching arrangement it is possible to duplicate any condition encountered in actual service. The automatic heating equipment is actuated by thermostats which obtain the heat for their operation from 15-watt light bulbs placed directly under the thermostatic tubes. When the equipment cycles off by thermostatic action this light goes out and the tube cools. When it has cooled sufficiently, the thermostatic circuit is broken by the mercury in the tube and the heating equipment automatically goes to the "on" position. The use of this method permits an exact duplication of actual service operation of automatic heating equipment. By using "stick" circuits any magnetic valve can be stuck in either the open or closed position. This feature is very useful in demonstrating to train crews the indication and effect of stuck magnetic valves and instructing them in the proper procedure to follow when troubles of this nature occur.

The heating control circuits are so wired that the same valves are actuated by four different types of control equipment. In this end of the car are also located all types of generator regulators, lamp regulators and other electrical control equipment in general use on Missouri Pacific cars. This equipment is used principally for the instruction of maintenance forces, but it is also useful for instructing train crews in the location of various fuses and the safe method of replacing them if they burn out enroute.

The other end of the car which is shown in another of the illustrations, is devoted entirely to the instruction of maintenance forces. The seats were removed from one side of the car and replaced with a long table on which is mounted cutaway sections of all essential parts of the various types of air-conditioning systems. There are also two large diagrams of the steam-ejector system and two blackboards for diagraming and explaining

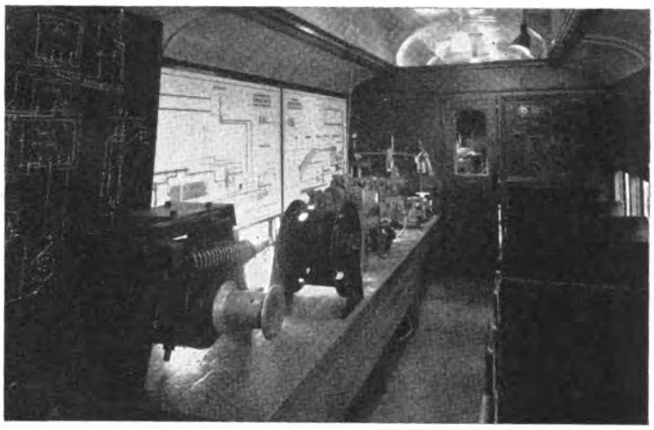


One end of the car is equipped with control apparatus for the instruction of train crews

problems which arise in maintenance work. It also contains a standard car-lighting generator which can be motored from any of the generator control equipment located in the other end of the car.

Power for operating pumps, fans and control equipment is secured from a 36-cell 45-volt Edison battery which has a 32-volt tap. With both 45 and 32 volts available, it is possible to reproduce a condition identical with that which obtains when the train is running or standing.

The introduction of air conditioning has changed entirely the standard of car electrical work and all maintenance men are required to visit the car and demonstrate their proficiency in the adjustment of regulators, automatic switches, contactors, relays, etc. The lamp regulators are so wired that they can be loaded from 5 to 75 amp. and are connected on both the regulated and



Cut-away models and diagrams of air-conditioning and car electrical apparatus are used for the instruction of maintenance forces

unregulated sides to a volt-ammeter which serves as a check on the regulator adjustments made by the maintenance men.

During the first trip over the Missouri Pacific, 728 trainmen and 60 maintenance men received instruction in the car.

Questions and Answers On the AB Brake

Operation of the Equipment (Continued)

161—Q.—*How long does the local brake-pipe reduction into the quick-service volume continue?* A.—Until the slide valve moves, at which time the quick-service volume is cut off.

162—Q.—*What becomes of the remaining air pressure in the quick-service volume?* A.—As this volume is always connected to the atmosphere through the preliminary quick-service choke, the remaining air is exhausted.

163—Q.—*What takes place in the emergency portion during the period known as preliminary quick service?* A.—The emergency piston and graduating valve assume service position.

164—Q.—*In what direction and how far does the emergency piston move?* A.—To the right until the piston-spring guide strikes the left end of the emergency slide valve.

165—Q.—*Is the quick-action charging choke now open?* A.—No, in this position it has been closed by the piston.

166—Q.—*What reduction of pressure is now being made in the emergency portion, in addition to that of the brake pipe?* A.—Quick-action-chamber air is being exhausted to the atmosphere via the vent port through the graduating valve to a port in the slide valve which registers with the exhaust port in the emergency slide-valve seat.

167—Q.—*At what rate is this reduction being made?* A.—At the same rate that brake-pipe pressure is reduced on the face of the emergency piston.

168—Q.—*Why is the reduction of quick-action-chamber air made?* A.—To keep quick-action-chamber pres-

sure from attaining a differential over the brake pipe.

169—*Q.—What is the reason for this precaution?* A.—If this were not done, the higher quick-action-chamber air would exert sufficient force against the emergency piston to compress its spring. This would allow the graduating valve to uncover a port connecting quick-action-chamber air to the emergency-piston chamber causing an emergency application.

170—*Q.—What is the general effect of this feature?* A.—By this means the valve is stabilized against an undesired emergency application, and the emergency application is made available at any time.

171—*Q.—During the preliminary quick-service reduction, has any braking pressure been developed?* A.—No. The service slide valve has not moved, and the brake cylinder is still connected to the atmosphere through the retaining valve.

172—*Q.—Has any reduction of auxiliary-reservoir pressure taken place as yet?* A.—No.

173—*Q.—At what stage does brake-cylinder pressure begin to develop?* A.—When the auxiliary-reservoir pressure has attained a sufficient differential over the brake pipe to move the service piston to the extreme left, into service position.

174—*Q.—What pressures connect with the brake cylinder at this juncture?* A.—The brake cylinder is connected indirectly to the auxiliary reservoir and brake pipe.

175—*Q.—How does the brake-pipe air pass to the brake cylinder?* A.—From a passage leading to the service slide-valve seat, connecting with cavity *D* in the slide valve, thence through a passage to the limiting valve, lifting the back-flow check and flowing past the limiting-valve check to the under side of the limiting-valve diaphragm. From there the pressure flows to the brake cylinder via the inshot valve.

176—*Q.—In what way is the auxiliary reservoir connected to the brake cylinder?* A.—Past the right end of the graduating valve, through the service slide valve and seat to passages leading to the brake cylinder through the inshot volume and the inshot valve.

177—*Q.—What causes the inshot valve to remain open at this time?* A.—Brake-cylinder air flows through a passage in the emergency portion through cavity *K* in the emergency slide and through a passage to the inshot volume and chamber at the left of the inshot piston. Brake-cylinder pressure is now on both sides of the inshot piston. As the spring at the left of the piston is stronger than the one to the right of the inshot valve, the piston and valve move to the right. The inshot valve is still open and a direct build-up of brake-cylinder air is permitted.

178—*Q.—What limits the amount of brake-pipe flow to the brake cylinder?* A.—As the brake cylinder pressure is built up, it also increases under the limiting-valve diaphragm. When this pressure is approximately 9 lb. the diaphragm is deflected upward against the force of its spring, allowing the limiting-valve check to close, due to the force of the spring beneath the check.

179—*Q.—What does the closing of the limiting valve bring about?* A.—It cuts off the flow of brake pipe air to the brake cylinder and ends all quick-service activity.

180—*Q.—When cycling on descending grades what degree of quick service is obtained when the brakes are reapplied with the retainer in holding position?* A.—The first quick-service stages, as covered in preliminary quick service. The additional quick service, which is obtained with an initial application, is cut off when approximately 10 lb. brake-cylinder pressure is retained.

181—*Q.—What movement takes place in the emergency portion during service?* A.—The same as described for preliminary quick service.

182—*Q.—What movement of the service portion takes place when the valve assumes service lap position?* A.—When the desired brake-pipe reduction has been made, and auxiliary-reservoir pressure has been reduced slightly below the brake-pipe pressure, the service piston and graduating valve move to the right until the piston stem engages the slide valve.

183—*Q.—What is the result of this movement.* A.—The graduating valve blanks the service port and cuts off the flow of air from the auxiliary reservoir to the brake cylinder.

184—*Q.—What takes place in the emergency portion at this time?* A.—The emergency piston and graduating valve return to the charging position.

Decisions of Arbitration Cases*

(The Arbitration Committee of the A.A.R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

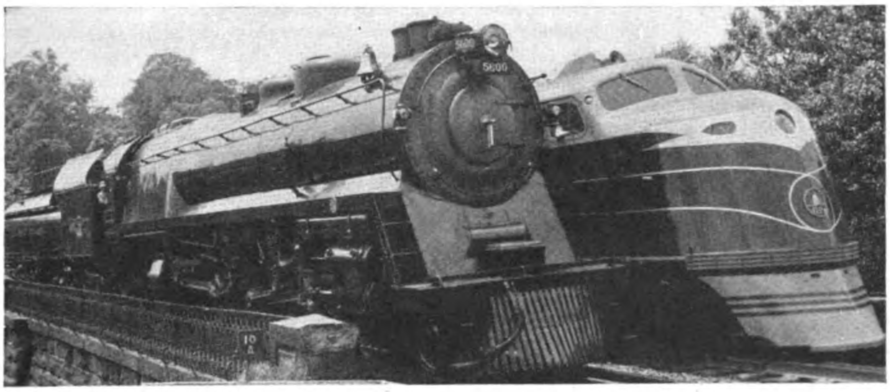
Charge for Brake Beams Prior to Authorization of Betterment Charge

During April, May, June and July, 1934, the Chicago & North Western applied 167 No. 15 brake beams to Pacific Fruit Express cars to replace 160 No. 2 plus and seven No. 2 brake beams which had been removed. A net material charge of $4.08, in addition to the usual labor charge, was made for each substitution for a No. 2 plus beam and $4.18 for each substitution for a No. 2 beam.

The car owner requested the repairing line to confine the material charge to the value of the No. 2 plus beam citing Section (e) of Rule 17 and Interpretation No. 19 of the same rule in effect at the time of repairs. The C. & N. W. declined to honor the claim because of the fact that, after the No. 15 brake beams had been adopted as the A.A.R. standard by letter ballot action on March 1, 1934, it discontinued perpetuating the No. 2 plus brake beam and confined purchases of new brake beams for freight cars to the No. 15 beam. When the supply of No. 2 plus brake beams at repair points became exhausted it was necessary to use a No. 15 brake beam in lieu of a No. 2 brake beam in order to make proper repairs and expedite the movement of cars. In the absence of an arbitrary price covering this brake beam prior to August 1, 1934, the C. & N. W. billed car owners at invoice cost plus 15 per cent which resulted in a lower charge than the price set up in the rules effective August 1, 1934.

In a decision rendered Nov. 14, 1935, the Arbitration Committee said, "Although the No. 15 brake beam had been adopted by letter ballot as an A.A.R. standard as of March 1, 1934, no prices for same were incorporated in the Interchange Rules until August 1, 1934. This being the case, and as repairs were made prior to August 1, 1934, charge for the No. 15 brake beams applied in place of No. 2 and No. 2-plus standard to car, should be confined to price of the No. 2-plus beam in effect on date of repairs. The contention of the C. & N. W. is not sustained."—*Case No. 1747, Pacific Fruit Express versus Chicago & North Western.*

* (Note—A number of readers have inquired during recent months as to the reason for the discontinuance of publication of abstracts of arbitration decisions. The decision presented here, in Case No. 1747 is the first released for several months. The decision in Case No. 1746 was published on page 118 of the March, 1936, issue of *Railway Mechanical Engineer*.)



The B. & O.'s latest development in steam power beside its 3,600-hp. Diesel-electric

NEWS

P.R.R. Builds Passenger Cars

THE Pennsylvania has about completed in its Altoona, Pa., works the construction of 100 modernized passenger cars, comprising 60 coaches, 8 combined passenger-baggage cars, 30 dining cars and 2 safe-coaches.

1,000 Car Order to Require Opening of A. C. F. Plant

FOLLOWING receipt of an order for 1,000 ballast cars,. which will be built for the Rodger Ballast Car Company for delivery to the Union Pacific, the American Car & Foundry Company will reopen its plant at Madison, Ill., on a large scale for the first time in seven years. The wheel department of this plant was reopened about three months ago and employs about 125 men. About 700 more men will be needed for the car department.

Smoke Prevention Convention Cites Railroad Aid

AT the 1937 convention of the National Smoke Prevention Association in New York it was brought out in various discussions that the railroads entering large cities have reduced to a minimum that fraction of total air pollution attributable to locomotives. At the sessions reserved as "Hudson County (N. J.) Day," J. L. Hodges of the Department of Smoke Regulation, Hudson County, cited statistics revealing that the trunk line railroads terminating on the New Jersey shore opposite New York City have reduced locomotive smoke from 23.5 per cent of the total pollution in 1931 to 1.24 per cent in 1937, as recorded through the facilities of the Hudson County Smoke Prevention Association. These figures compare favorably with the results of similar tests made at Stevens Institute, Hoboken, N. J.

Davis of Stevens A.S.M.E. Presidential Nominee

NOMINATIONS for officers of the American Society of Mechanical Engineers for 1938, as announced by the nominating committee at Detroit, Mich., during the semi-annual meeting of the Society, May 17 to 21, are the following: For president: H. N. Davis, president, Stevens Institute of Technology, Hoboken, N. J. For vice-president, to serve one year: F. O. Hoagland, master mechanic, Pratt & Whitney Division, Niles Bement-Pond Co., Hartford, Conn. For vice-presidents, to serve two years: B. M. Brigman, Dean, Speed Scientific School, University of Louisville, Louisville, Ky.; Harte Cooke, mechanical engineer, American Locomotive Company, Diesel Engine Division, Auburn, N. Y.; W. H. McBryde, consulting engineer, San Francisco, Calif., and L. W. Wallace, director, equipment research, Association of American Railroads, Chicago. For managers, to serve three years: Carl Bausch, vice-president, Bausch & Lomb Optical Co., Rochester, N. Y.; S. B. Earle, dean, School of Engineering, Clemson A. & M. College, Clemson College, S. C., and F. H. Prouty, Prouty Brothers Engineering Co., Denver, Colo.

Pennsylvania Developing a New Steam Locomotive

THE Pennsylvania, in co-operation with a committee of engineers of the Baldwin, American and Lima locomotive companies, is developing a new type of steam locomotive to be known as "The Pennsylvania Type," it is announced by M. W. Clement, president of the road. A development of the conventional coal-burning steam type, to cost little more to build, operate and maintain than present locomotives of lesser capacity, the new unit will be capable of hauling a 14-car passenger train at 100 miles an hour and will render service comparable to the motive power on the electrified eastern lines of the road.

This type will be the largest, fastest, and most powerful steam engine ever designed primarily for passenger service on the Pennsylvania. Having the same general appearance as the streamline type of heavy steam passenger locomotive now in service, the new locomotive, a 4-4-4-4 type, will carry two pairs of cylinders on a rigid frame, each pair providing power for four driving wheels. The tender, mounted on two six-wheel trucks, will have a maximum capacity of 25,000 gallons of water and 26 tons of coal. As soon as one of the new type locomotives is completed, road and plant tests will be made to determine its practical adaptation to various transportation needs.

Recent B. & O. Locomotive Designs

RECENT additions to Baltimore & Ohio motive power include a 3,600-hp. Diesel-electric locomotive from the Electro-Motive Corporation—one of two similar units for service on the "Capitol Limited" between Washington, D. C., and Chicago—and a 4-4-4-4 type passenger steam locomotive named the "George H. Emerson" in honor of the present chief of motive power and equipment of the road.

Identical in capacity and wheel loadings with the locomotive recently built for the Santa Fe's "Super Chief," each of the 3,600-hp. streamline locomotives is composed of two 1,800-hp. units coupled for multiple-unit operation, with a single control station in the cab of the leading unit. The motive power for each 1,800-hp. unit is identical and consists of two 900-hp. Electro-Motive power plants controlled simultaneously from the main locomotive throttle. The total weight of each locomotive, with full fuel supply, water and sand, is about 569,000 lb.

The 4-4-4-4 type steam locomotive, completed on June 3 in the Mt. Clare shops of the B. & O., is a single-expansion unit having four cylinders cast in an integral frame, approximately 60 ft. long. It is equipped with a fire-tube boiler with water-tube firebox carrying 350 lb. pressure and has a rigid wheel-base of 6 ft. 7 in. Double-ported piston valves, which were discontinued several years ago, after installation on a number of B. & O. engines, have been reincorporated in modified design on the locomotive. The tender and engine, together, weigh 736,500 lb.

While designed specifically for passenger service, the locomotive can also be utilized in high-speed freight service.

New Enginehouse Construction

The Wabash is constructing, with its own forces, a reinforced concrete and frame enginehouse at Brooklyn, Ill., to replace a frame structure. The work is being done at a cost of $26,500.

The St. Louis Southwestern has undertaken the alteration and enlargement of its enginehouse at Pine Bluff, Ark., at a cost of about $90,000. Several small buildings have also been constructed at this point and new shop machinery has been installed. The total cost of the improvements will approximate $300,000.

The Chicago, Burlington & Quincy has awarded a contract to the B. Jobs Construction Company, Peoria, Ill., for additions and extensions to its enginehouse at Galesburg, Ill. This work, which will cost about $80,000, will involve the construction of a six-stall addition to the present enginehouse and the extension of three stalls. Another contract has been awarded to G. A. Johnson & Sons, Chicago, for the construction of a new six-stall enginehouse at Rock Island, Ill., at a cost of about $35,000.

N. Y. Commission Defines "Engine" in Helper Case

POINTING out that rolling-stock customarily known as a "motor-car" cannot be construed as comprising an "engine," the Public Service Commission of the State of New York, recently discontinued a proceeding brought on a complaint of the Brotherhood of Locomotive Firemen and Enginemen, alleging that the Erie is violating a state statute prohibiting the operation of any "fuel-electric engine" within the state unless it be manned by a crew of not less than one engineer and one fireman, or helper.

The equipment referred to in the case comprises gasoline-electric motor cars consisting of an engine compartment, which occupies less than one-quarter of the length of the car, and baggage, express and passenger compartments.

The commission's opinion states that the question arises as to whether the equipment in question may properly be called, in the ordinary acceptation of the term, "fuel-electric engines," and adds that the starting point of the case is the legal rule that, unless a term is defined in the statute, it is to be considered as it is generally understood. It felt that an "engine," as currently known, does not carry passengers or property and does not include compartments for the handling of mail, express or baggage but is solely, or at least primarily, for the purpose of hauling or moving other rolling-stock.

Power Reverse Gear Order Mandatory

HOLDING that "the use on steam locomotives of manually operated reverse gear, as compared with power reverse gear, causes unnecessary peril to life or limb, and that the safety of employees and travelers on railroads requires that suitable power-operated reverse gear shall be substituted for manually operated reverse gear," the Interstate Commerce Commission, speaking through Commissioner McManamy, on June 14, issued an order requiring the installation of power reverse gear on all new steam locomotives built after September 1, and further specifying that all steam locomotives used in road service built prior to September 1, which weigh on driving wheels 150,000 lb. or more, and all steam locomotives used in switching service built prior to September 1, which weigh on driving wheels 130,000 lb. or more, shall have a suitable type of power-operated reverse gear applied the first time after September 1 that these locomotives are given repairs defined by the United States Railroad Administration as class 3 or heavier. The order goes further to say that all such locomotives shall be so equipped before September 1, 1942. In installations where steam connections to air operated power reverse gear are used, the operating valves shall be conveniently located in the cab of the locomotive and so arranged and maintained that in case of air failure steam may be quickly used to operate the reverse gear.

The report estimates the cost of installation of power reverse gear on locomotives that do not now have it at about $5,000,000. The commission does not feel that the cost of equipping these locomotives will be unduly burdensome to the carriers, for, as the report says, "the record justifies a conclusion that the additional cost of equipping with power reverse gear a locomotive receiving class 1, 2, or 3 repairs is negligible."

I.C.C. Hears Arguments in Power Reverse Gear Case

ON May 18 the Interstate Commerce Commission heard arguments as to the advisability of issuing a formal order requiring the railroads to install power reverse gears in their locomotives. Joseph H. Wright, counsel for the Illinois Central, and W. Carter Fort, of the Association of American Railroads, strongly urged the commission to either dismiss the case or simply reserve decision on it and let the railroads and the brotherhoods work out the agreement which has been reached with 131 Class I railroads. Mr. Fort said that the agreement included 97 per cent of all the locomotives owned by the railroads of the United States. He strenuously objected to the examiner's report in the power reverse gear case and said that the reading of the case will not disclose whether the hand gear or the power gear is the most dangerous.

Coming to the question of the agreement which has been signed by both the Brotherhood of Locomotive Engineers and the railroads, Commissioner McManamy asked

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New Equipment Orders and Inquiries Announced Since the Closing of the June Issue

		LOCOMOTIVE ORDERS	
Road	No. of locos.	Type of loco.	Builder
Baltimore & Ohio	2 [1]	3,600-hp. Diesel-elec.	Electro-Motive Corp.
Canton R. R. Co.	1	600-hp. Diesel-elec.	Electro-Motive Corp.
C. & N. W.	1 [2]	4-6-4	American Loco. Co.
Chinese Ministry of Railways	10	2-8-2	Baldwin Loco. Wks.
	10	2-8-2	American Loco. Co.
East Erie Commercial R. R.	1 [3]	300-hp. Diesel-elec.	General Elec. Co.
N. Y., N. H. & H.	6	3,600-hp. d.c. elec.	General Elec. Co.
Norfolk & Western	10 [4]	2-8-8-2	Company shops
		Locomotive Inquiries	
C. M., St. P. & P.	1 [5]	Pass.	....
Newfoundland	1	2-8-2	....
		FREIGHT-CAR ORDERS	
Road	No. of cars	Type of car	Builder
C. M., St. P. & P.	1,000 [5]	Gondola	Company shops
Norfolk & Western	20 [4]	Caboose	Company shops
	10 [4]	Hopper	Company shops
Owens-Illinois Glass Co.	50	Hopper	Gen. Amer. Trans. Corp.
Seaboard Air Line	200	50-ton auto. box	Pullman-Std. Car Mfg. Co.
Union Pacific	2,788 [6]	Frt.	Company shops
United States Sugar Corp.	60	30-ton cane	Magor Car Corp.
		Freight-Car Inquiries	
C. & N. W.	50	Caboose-car underframes	....
Ill. Central	25	50-ton hopper	....
M. St. P. & S. S. M.	100	50-ton box	....
		PASSENGER-CAR ORDERS	
Road	No. of cars	Type of car	Builder
Canadian National	10	Mail-express	Canadian Car & Fdry. Co.
C. R. I. & P.	10	Coaches	Pullman-Std. Car Mfg. Co.
		Passenger-Car Inquiries	
New York Central	6	Diners	....
	4	Bagg. and mail	....

[1] Delivered.

[2] In addition to eight ordered in February.

[3] Equipped with Cooper Bessemer power plant.

[4] The Norfolk & Western will construct at an approximate cost of $1,600,000 in its Roanoke, Va., shops 10 heavy freight locomotives of the Y-6 (2-8-8-2) class, 20 new all-steel caboose cars and 10 all-steel covered hopper cars of 70 tons' capacity, the latter designed for hauling cement and similar commodities. Material for these new locomotives will be ordered immediately and construction will start about October. It is expected that four of the locomotives will be completed this year. They will be equipped with roller bearings, mechanical lubrication, will have a tractive force of about 127,000 lb. and locomotive and tender weight, in working order, of 961,500 lb. The locomotives are to be the same type (Y-6) as five others built at Roanoke last year. The shop forces will start construction on the 20 caboose cars as soon as plans are completed and material received.

[5] Purchase authorized by the Federal district court at Chicago, the locomotive at a cost of $125,000, and the gondola cars at a cost of $2,562,000.

[6] The Union Pacific has placed orders with company shops for 2,788 freight cars, instead of 2,600, as reported in the June issue. Of these, 2,088 box cars will be constructed at the Omaha and Portland shops, while 700 auto box cars will be constructed at the Grand Island shops. In addition, orders will be placed with company shops, or outside builders, for 100 special box cars, but inquiries have not yet been issued.

Mr. Fort what recourse the employees had if the railroads chose to break the agreement. Mr. Fort replied that he thought that the lines would not dare to do such a thing. If they did, he did not feel that the unions would have any legal recourse.

Questioned by Commissioner Mahaffie as to whether the Brotherhood of Locomotive Engineers was willing to have the commission dismiss the case, H. M. McLaughlin, attorney for the Brotherhood, said that he did not know what their attitude would be on that question, but that he felt that the agreement was satisfactory and that the brotherhoods would live up to their part of it and that they expected the railroads to do the same.

Motion Picture Dramatizes Industrial Lubrication

A motion picture dramatization of lubrication methods in modern industry, which was developed by the Industrial Department of the Socony-Vacuum Oil Company, was shown for the first time recently in the preview theatre of Radio City Music Hall, Rockefeller Center, New York. The new film is done in a "March of Time" style. Animated drawing and photography are used to illustrate correct lubrication of various types of machinery.

The picture is called "The Inside Story." A microscopic film of oil assumes the hero's role in this industrial drama. But for this film of oil, the picture points out, many of the common daily conveniences of modern life, now within the reach of millions of people, would never have been possible. The story of the fundamentals behind correct lubrication is told by showing bearings, gears and cylinders—the essential elements of all machines—and demonstrating how they operate, how they are lubricated and the lubrication needs of various types.

Various bearings are shown and an animated drawing shows just what goes on inside, how lubrication prevents metal to metal contact. Factors to be taken into consideration in the selection of the proper lubricant are fully explained. In a similar way, the lubrication of gears is illustrated with animated drawings showing how a gear transmits power and how the lubricant provides protection. Another series of pictures shows the work that correct lubrication does in protecting the moving parts of various prime motors, the Diesel engine being selected as an example. Animated drawings make clear the principle upon which the engine operates and the manner in which explosions are translated into usable power. Further drawings illustrate what a lubricant must do if efficient operation is to be maintained.

The new film will be shown to business organizations and to groups of plant managers and factory executives in industrial communities throughout the country.

Supply Trade Notes

The Westinghouse Electric & Manufacturing Company has opened Pittsburgh, Pa., executive, sales, and lamp division offices, at 306 Fourth avenue.

Frank M. Morley, formerly with the Bethlehem Steel Company, is now in the sales department of the Graham-White Sander Corp., with headquarters at Roanoke, Va.

C. Miles Burpee, research engineer of the Delaware & Hudson, has resigned to become vice-president of the railroad division of the Chipman Chemical Company, Bound Brook, N. J., with headquarters at Chicago.

Steel and Tubes, Inc., Cleveland, Ohio, has moved its New York district sales offices, from 30 Rockefeller Plaza, to the Chrysler building, New York City; L. M. Hogan is district sales manager.

Robert W. Law has been appointed division manager of the Boston, Mass., office of the A. M. Byers Company, 518 Consolidated building. Mr. Law has been with this company since 1925 as sales representative in the New York division.

The Hart & Cooley Manufacturing Company, Chicago, has added a second addition to its factory at Holland, Mich. J. H. Van Alsburg, engineer of application, has been promoted manager of the contract department, which handles all items manufactured for railroad use.

The Columbia Steel Company, subsidiary of the United States Steel Corporation, San Francisco, Cal., has made appointments in its general sales department, as follows: J. D. Fenstermacher has been appointed manager of sales, Steel Casting and Railroad Sales Division; E. S. Duval has been appointed manager of sales, alloy and stainless steel products, and F. R. Steckel assistant manager of sales, alloy and stainless steel products.

Dudley A. Bonitz, a sales representative of the Ryan Car Company, Chicago, has been appointed to the newly-created position of sales manager. C. D. Hicks has been appointed sales agent in the St. Louis territory with headquarters at 1218 Olive street, St. Louis.

J. P. Boore has been appointed assistant general sales manager of the Babcock & Wilcox Tube Company, Beaver Falls, Pa. Mr. Boore served for several years as vice-president of the Summerill Tubing Company, and for 20 years prior to that was associated with the Pittsburgh Steel Company in the production and sales departments.

Everett D. Graff, first vice-president of Joseph T. Ryerson & Son, Inc., Chicago, has been elected president. W. F. Kurfess and V. H. Dieterich, assistant vice-presidents, have been promoted to vice-presidents; Ainslie Y. Sawyer, assistant vice-president, has been promoted to assistant to the president. All have headquarters at Chicago.

The American Steel & Wire Co., subsidiary of the United States Steel Corporation, officially opened its new modern continuous rod mills at Joliet, Ill., on June 23. These mills are part of a $5,000,000 improvement program begun in billet mills in Gary and South Chicago. The mills are the first rod mills to be equipped throughout with anti-friction bearings. The total annual capacity is 22,000 tons.

The Dampney Company of America, Hyde Park, Boston, Mass., has opened a branch office in the Citizens and Southern National Bank building, Atlanta, Ga., in charge of Ray W. Carter, as southeastern district representative. Mr. Carter, for the past six years, was in charge of the New York office. L. W. MacLean of the Philadelphia, Pa., office has been transferred to New York.

C. W. Gilmer, manager mechanical sales, at the Seattle, Wash., branch for the Mechanical Goods Division of United States Rubber Products, Inc., has been transferred to the New York office as belting sales engineer, operating under T. A. Bennet, manager belting sales; L. F. Koepp, salesman in the Seattle district, has been appointed manager mechanical sales, succeeding Mr. Gilmer at the Seattle branch.

K. W. Green has been appointed manager of railway sales of The Electric Storage Battery Company, Philadelphia, Pa., manufacturers of Exide batteries. Mr. Green was graduated as an electrical engineer from Lehigh University, class of 1924. He then took the students' training course at the Bethlehem Steel Company, and worked in the electrical department for three years. He entered the employ of The Electric Storage Battery Company in July, 1927, and served for five years on the sales staff of the Pittsburgh branch before going to Philadelphia.

The Officers of the Burden Iron Company, Troy, N. Y., are now as follows: Joseph W. Burden, chairman of the board; Charles P. Franchot, president; Otis A. VanDenburgh, vice-president in charge of operation; Harold T. Henry, vice-president in charge of sales; Charles Downs remains as treasurer; Grace W. Foster, formerly assistant secretary, is secretary; George W. Heger is assistant treasurer; and William G. Shoemaker is assistant secretary. The company has moved its New York City office to 60 East 42nd street.

The Electro-Motive Corporation has started another addition to its Diesel locomotive plant at La Grange, Ill. This addition, consisting of a one story building 360 ft. wide by 816 ft. long, and located west of the present main building, will be used for manufacturing Winton two-cycle

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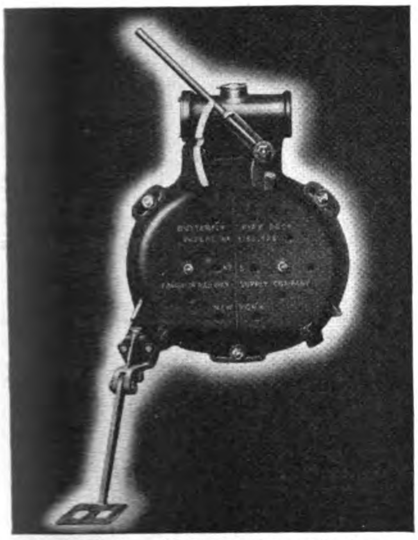
• MORE MILEAGE

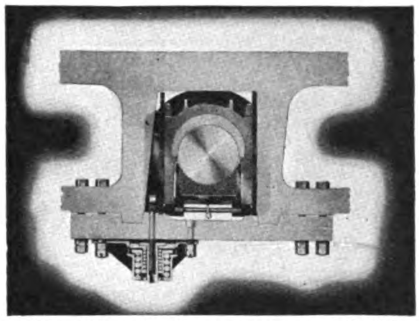
• BETTER SERVICE

• LONGER LIFE

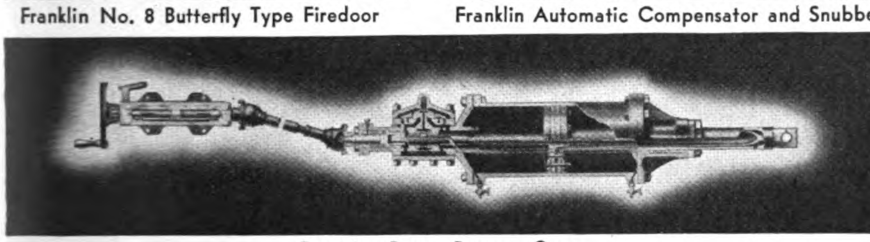
• LOWER COSTS



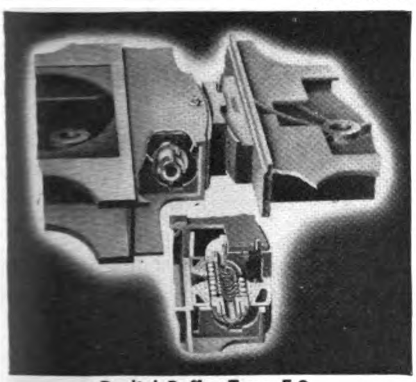
Franklin No. 8 Butterfly Type Firedoor



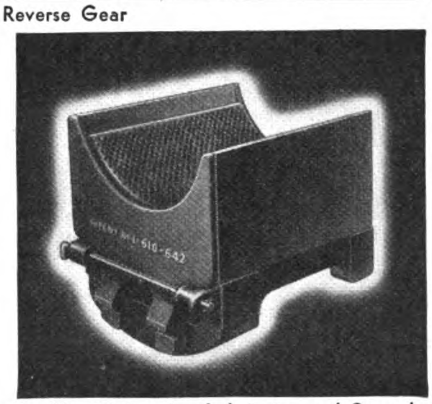
Franklin Automatic Compensator and Snubber



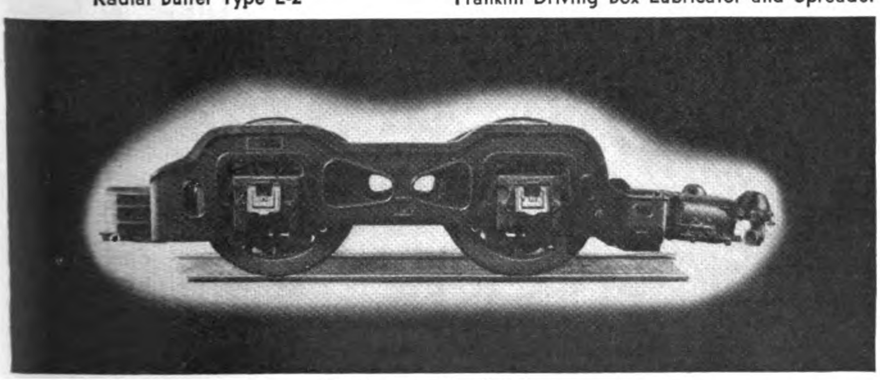
Precision Power Reverse Gear



Radial Buffer Type E-2



Franklin Driving Box Lubricator and Spreader



The Locomotive Booster

All these factors are built into Franklin Replacement Parts for Franklin Devices. » » » Replacement Parts are of major importance because they take the brunt of the service. » » » Into every Franklin Part is built the experience gained in the development of the device itself. » » » Only by duplicating this development work can this experience, essential to the making of duplicate parts, be gained. » » » Only by using genuine Franklin Replacement Parts for Franklin Devices can the same dependable performance and the same economy as given by the original part be obtained. » » » » » » » »

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

Diesel engines supplementary to the facilities at the Winton plant in Cleveland. This is the second addition to the plant since it was completed in January, 1936. The first addition, which doubled the size of the main building, was placed in service three months ago.

J. J. SUMMERSBY, assistant vice-president of the Worthington Pump & Machinery Corporation, Harrison, N. J., has been appointed general sales manager of the corporation. This is an extension of Mr. Summersby's previous responsibilities, for a further concentration of direction of the corporation's general sales department. Mr. Summersby joined the corporation as a sales engineer immediately after his completion of post graduate work at Washington University in 1920, and he has been continuously in that service since that time as district sales manager, divisional sales manager and assistant general sales manager.

J. F. HOERNER, district manager at New York of the Baldwin Locomotive Works, has been appointed assistant general sales manager, with headquarters at Philadelphia, Pa. Victor E. Rennix, who entered the sales department in 1918, and was

J. F. Hoerner

transferred to Chicago as assistant to the district manager in 1933, succeeds Mr. Hoerner as district manager at New York, and Henry K. Patjens, who has been with Baldwin in the engineering department from 1919 until early in the present year, when he was transferred to the sales department, has been assigned to the Chicago district office, in place of Mr. Rennix. Mr. Hoerner started work with the Baldwin Locomotive Works in 1909 and served in the engineering department until 1915, when he was transferred to the New York sales force. From 1919 to 1921 he was assistant manager of the New York office and until 1928 was assistant to the vice-president at New York, since which time he has served as district manager at New York.

H. B. SPACKMAN, formerly general sales manager of the Steel Products Division of the U. S. Gypsum Company, Chicago, has been appointed general sales manager of Lyon Metal Products, Incorporated, Aurora, Ill., and will have supervision of all sales activity, including advertising and sales promotion. Mr. Spackman entered the employ of Lyon Metal Products, Inc., after 18 years experience in the metal fabrication industry. For nine years he was connected with the Northwestern Expand-

H. B. Spackman

ed Metal Company as a salesman and later as assistant general sales manager. Upon resigning from this company he entered the employ of the U. S. Gypsum Company, where he developed a steel equipment division for the marketing of building material specialties. He resigned as general sales manager of the steel products division of the U. S. Gypsum Company to become general sales manager of Lyon Metal Products, Inc.

D. W. LAMOREAUX, vice-president of the Journal Box Servicing Corporation, with headquarters at Chicago, has been elected vice-president of the Peerless Equipment Company, Chicago. Mr. Lamoreaux was born in Elmvale, Ont., in 1887 and entered railway service as a machinist for the Wheeling & Lake Erie at Brewster, Ohio. After holding this position for several years, he entered the employ of the Baltimore & Ohio and later the Pennsylvania and the New York Central, working up from the position of machinist to fore-

D. W. Lamoreaux

man and general foreman. He returned to the Wheeling & Lake Erie as general foreman and several years later resigned to become sales engineer for the National Refining Company, with which company subsequently he was promoted to manager of sales. He held the latter position until 1932, when he was elected vice-president of the Journal Box Servicing Corporation at Indianapolis. Two years later he was placed in charge of this company's Chicago office, which position he has held until his recent appointment.

A. A. HELWIG, president of the Peerless Equipment Company, Chicago, has resigned to become vice-president of the Standard Railway Equipment Company, Chicago. Mr. Helwig was born at Minneapolis, Minn., in 1892, and served his apprenticeship in the mechanical department of the Minneapolis & St. Louis. Later he was employed in train service on this railroad, the Great Northern and the Chicago, Milwaukee, St. Paul & Pacific. In 1915 he was appointed general foreman of the Alton at Kansas City, Mo., and the following year became traveling inspector in the mechanical department. In 1917 he entered the army as a second lieutenant and in 1920 resigned as a major after serving three years in France with the First Army Engineers. He returned to

(c) Moffett Studio
A. A. Helwig

railroad service in that year as superintendent of the car department of the Kansas City Terminal Company at Kansas City, and in 1925 resigned to become southwestern sales manager of the Bradford Corporation, with headquarters at St. Louis, Mo. In 1930 he was elected vice-president at Chicago and in March, 1932, resigned to form the Peerless Equipment Company, of which he was elected president on January 1, 1936.

Obituary

WILSON WORKMAN BUTLER, president of the Canadian Car and Foundry Company, died recently at Montreal, P. Q. Mr. Butler was born at Danville, Ohio, on December 9, 1862, and was educated in that state at the Danville Select School. He gained his business experience in the service of the John Shillito Company, Cincinnati, Ohio, and as western manager for the Sterlingworth Railway Supply Company, Chicago. In 1901 he went to Canada and established the manufacturing plant of the Simplex Railway Appliance Company and afterwards founded the Dominion Steel Car Company, where the first Canadian all-steel railway car was built

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under his supervision. Several years later Mr. Butler took an active part in the organization of the Canadian Car and Foundry Company, of which he was a director, as well as president. He was also president and director of the Canadian Steel Foundries, Ltd., and Pratt and Letchwork Company, Ltd. At various times he held business affiliations in the United States, including that of western sales agent for the American Car and Foundry Company, as second vice-president and director of the Simplex Railway Appliance Company, and second vice-president and director of American Steel Foundries.

Personal Mention

General

W. A. Pownall, mechanical engineer of the Wabash, has been appointed assistant to superintendent motive power, with headquarters at Decatur, Ill.

W. H. Sagstetter, assistant superintendent motive power of the Wabash, with headquarters at Decatur, Ill., has resigned to become general mecnanical superintendent of the Denver & Rio Grande Western, with headquarters at Denver, Colo. The position of general mechanical superintendent of the D. & R. G. W. has remained unfilled since the middle of 1936, when W. J. O'Neill resigned to become superintendent motive power of the Western Pacific. During the interim P. C. Withrow, mechanical engineer of the D. & R. G. W., has served as acting general mechanical superintendent.

W. B. Whitsitt, mechanical engineer of the Baltimore & Ohio, has been appointed assistant chief of motive power and equipment in charge of engineering and research work, with headquarters at Baltimore, Md. Mr. Whitsitt was born on May 27, 1883. He entered the service of the Baltimore & Ohio as draftsman in the motive-power department at Newark, Ohio, on March 16, 1903, and on April 1, 1907, was transferred to the Mount Clare shops at Baltimore. On October 1, 1915, he was appointed apprentice instructor at Mount Clare. He became assistant chief draftsman on September 1, 1917; chief draftsman on July 16, 1918, and assistant mechanical engineer on October 1, 1922. On November 1, 1926, Mr. Whitsitt was appointed mechanical engineer.

E. E. Sanford, master mechanic of the Buffalo and Montpelier divisions of the Wabash, with headquarters at Montpelier, Ohio, has been promoted to assistant superintendent motive power, with headquarters at Decatur, Ill., to succeed W. H. Sagstetter, who has resigned. Mr. Sanford has been identified with the Wabash for 34 years. He was born on October 26, 1885, at Chariton, Iowa, and received his education at the University of Missouri. He entered railway service with the Wabash in January, 1903, as an apprentice in the mechanical department at Stanberry, Mo., where he later served as a machinist, and then general foreman. In 1920, Mr. Sanford was sent to Moberly, Mo., as enginehouse foreman, later being appointed general foreman at the same point. In 1926 he was promoted to assistant master mechanic, which position he held until 1931, when he was further promoted to master mechanic at Ft. Wayne, Ind. In 1936, his office was moved to Montpelier, where he remained until his promotion to assistant superintendent motive power.

J. J. Tatum, general superintendent of the car department of the Baltimore & Ohio, has been appointed assistant chief of motive power and equipment, in charge of the car department, with headquarters at Baltimore, Md. Mr. Tatum has been in continuous service of the Baltimore & Ohio for 58 years. He was born at Baltimore on September 17, 1866, and entered the service of the B. & O. as a messenger at the Mount Clare shops on his thirteenth birthday. From December, 1879, to November, 1881, he worked in the locomotive building and repair shop, and later served as apprentice in the car department. He became a car builder in 1885 and in September, 1886, became supervisor of air-brake equipment. In the following 12 years he occupied various positions in the shops in a supervisory capacity, and in 1898 became general foreman of passenger terminals. In 1900 Mr. Tatum was appointed chief inspector of new car equipment and, in 1902, was promoted to the position of general foreman of the car department, Baltimore terminals and shops. He became superintendent of freight car equipment in 1907 and during the war was manager of the car repair section under the U. S. Railroad Administration, with headquarters at Washington, D. C. He returned to the Baltimore & Ohio on March 1, 1920, as superintendent of the car department, in charge of both passenger and freight equipment, and on June 1, 1925, was appointed general superintendent of the car department.

J. J. Tatum

Master Mechanics and Road Foremen

W. G. Rieck, general enginehouse foreman of the Wabash at Decatur, Ill., has been appointed master mechanic at Montpelier, Ohio, to succeed E. E. Sanford.

A. G. Gebhard, general foreman at the Markham (Chicago) roundhouse of the Illinois Central, has been promoted to master mechanic of the Louisiana division with headquarters at McComb, Miss., to succeed J. N. Chapman, who has been assigned to other duties.

Louis H. Wiebking has been appointed road foreman of engines of the Baltimore division of the Baltimore & Ohio, succeeding F. C. Turnley.

F. E. Trogler, traveling engineman, Pittsburgh division, of the Pennsylvania, has been appointed assistant road foreman of engines, Philadelphia Terminal division.

W. B. Weightman, assistant road foreman of engines of the Philadelphia Terminal division of the Pennsylvania, has been appointed assistant road foreman of engines, Philadelphia division.

W. E. Harnison, master mechanic of the Erie at Secaucus, N. J., has been transferred in the same capacity to Hornell, N. Y., and C. H. Norton, master mechanic at Hornell, has been transferred in the same capacity to Secaucus.

F. C. Turnley, road foreman of engines of the Baltimore division of the Baltimore & Ohio, has been appointed road foreman of engines of the Cumberland division, West End, succeeding C. Schuh, deceased.

M. G. Stewart, assistant road foreman of engines of the Philadelphia division of the Pennsylvania, has been appointed assistant road foreman engineer-assistant trainmaster, Wilkes Barre division, with headquarters at Mt. Carbon, Pa.

R. Skidmore, master mechanic in charge of the locomotive shop and enginehouse of the Kansas City Southern at Pittsburg, Kan., has had his jurisdiction extended to include the Northern and Kansas City Terminal divisions.

P. O. Christy, general foreman of the Illinois Central at Centralia, Ill., has been appointed assistant master mechanic at Markham (Chicago), in which capacity he suceeds to the duties of A. G. Gebhard.

J. M. Pierce, general master mechanic of the Kansas City Southern, with headquarters at Pittsburg, Kan., has been appointed master mechanic at Shreveport, La., with jurisdiction over the Southern and Port Arthur Terminal divisions, succeeding L. C. Kirkhuff, who has been assigned to other duties. The position of general master mechanic has been abolished.

Car Department

Frank C. Noel, formerly shop engineer of the Norfolk & Western at Roanoke,

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Va., has been appointed assistant foreman, passenger car shop.

JOHN J. O'BRIEN, superintendent of the car department of the Terminal Railroad Association of St. Louis, effective June 1, has at his own request been relieved of active supervision of car department matters and is appointed general car inspector. The duties relinquished by Mr. O'Brien will be assumed by Frank Ross, superintendent of motive power and equipment.

Shop and Enginehouse

A. CRAWLEY, day enginehouse foreman of the Wabash at Decatur, Ill., has been promoted to the position of general enginehouse foreman at Decatur.

Purchasing and Stores

WILLIAM R. CULVER, general storekeeper of the Chesapeake & Ohio, who has been promoted to superintendent of stores of this company, the New York, Chicago & St. Louis, and the Pere Marquette, with headquarters at Cleveland, Ohio, was born on July 15, 1884, at Tucson, Ariz. Mr.

William R. Culver

Culver entered railway service on July 1, 1902, with the Southern Pacific. On April 1, 1906, he was appointed assistant paymaster of the Southern Pacific of Mexico, holding this position until August 30, 1908, when he resigned to become division storekeeper of the National Railways of Mexico. On February 1, 1910, Mr. Culver rejoined the Southern Pacific of Mexico, being engaged on roadway accounting until March 31, 1911, when he was appointed chief of the material requisition bureau of the National of Mexico. On April 15, 1913, he left this company to go with the Pere Marquette as division storekeeper, being appointed traveling storekeeper in April, 1915, and general storekeeper in October, 1916. On August 1, 1917, Mr. Culver left railway service to become manager of factory sales of the Willys-Overland Automobile Company. Later he served with the Earle Motor Car Company as purchasing agent and supervisor of stocks. He re-entered railway service on August 1, 1923, as general storekeeper of the Pere Marquette. On November 1, 1931, he was made general storekeeper of the C. & O.

Obituary

KARL J. GOEBEL, general car foreman of the Delaware, Lackawanna & Western, with headquarters at Elmira, N. Y., died on June 8 of a heart attack, at the age of 43.

C. H. TEMPLE, who retired on September 1, 1928, as chief of motive power and rolling stock of the Canadian Pacific, with headquarters at Montreal, Que., died on May 29 at the age of 75.

MICHAEL J. COLLINS, general purchasing agent of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, died of heart disease on June 6 at his home at Chicago. Mr. Collins was 76 years of age and had been in railroad service for about 60 years, 50 years of which were spent with the Santa Fe.

ELDRED D. TOYE, general storekeeper of the Central region of the Canadian National with headquarters at Toronto, Ont., died on May 20, at his home following a brief illness. At the time of his death, Mr. Toye was a member of the General committee of the Purchases and Stores division of the Association of American Railroads.

GEORGE F. WILSON, formerly superintendent of motive power and equipment of the Chicago, Rock Island & Pacific, who retired from active service in 1910 as purchasing agent of the Delaware, Lackawanna & Western, died at Atlantic City, N. J., on June 29. Early in his railroad career Mr. Wilson served as a master mechanic on the Minneapolis & St. Louis, leaving this company in March, 1889, to become assistant general master mechanic of the Chicago, Kansas & Nebraska (part of the Rock Island) at Horton, Kan. Later he served as assistant general master car builder of the C. K. & N., and on October 7, 1889, became acting general master mechanic of the Rock Island. In February, 1890, Mr. Wilson was appointed general master mechanic, which position he held until June 8, 1891, when he became superintendent of motive power and equipment. In 1903 he left the Rock Island to become purchasing agent of the Delaware, Lackawanna & Western.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

ELECTRIC HEATING UNITS AND DEVICES.—Publication GED-650 of the General Electric Company, Schenectady, N. Y., lists small heating units of all kinds for industrial plants.

SHEET METALS.—Sections on U.S.S. galvanized sheet, black sheet and stainless steel are contained in the 64-page illustrated booklet issued by the Carnegie-Illinois Steel Corporation, Pittsburgh, Pa.

PORTABLE CRANE TRUCKS.—The four-page bulletin issued by The Elwell-Parker Electric Company, Cleveland, Ohio, illustrates and gives specifications for four types of portable crane trucks ranging in capacity from 1,000 to 10,000 lb.

WIRE SCREEN AND FILTER CLOTH.—The International Nickel Company, Inc., 67 Wall street, New York, has issued a 14-page booklet descriptive of the use of Monel for industrial screen and filter cloth problems.

MACHINING METALS.—The International Nickel Company, Inc., Development and Research Division, 67 Wall street, New York, has issued Bulletin T-12 descriptive of the machining of Monel, nickel and Inconel.

GRADE-O-METER.—A six-page folder descriptive of the Grade-O-Meter, an instrument for mechanically testing the strength of the bond of grinding wheels, etc., has been issued by the Abrasive Engineering Corporation, Stephenson building, Detroit, Mich.

MILLING CUTTERS.—National Adjusto-Lock inserted blade milling cutters are listed and described in the eight-page booklet issued by the National Twist Drill & Tool Co., Detroit, Mich. Positive locking of blades in any position and universal adjustment feature these cutters.

SEAMLESS FLEXIBLE TUBING.—The sixteen-page illustrated booklet, Bulletin SS-3, of The American Brass Company, American Metal Hose Branch, P. O. Box 791, Waterbury, Conn., discusses the essentials of construction and advantages of American Seamless flexible tubing and shows many typical installations.

OXYACETYLENE FLAME HARDENING.—The Airco process of flame hardening plain carbon steels, low-alloy steels, and certain semi-steels and low-alloy cast irons common to machine construction is discussed and its applications illustrated in the attractive 16-page booklet issued by the Air Reduction Sales Company, 60 East Forty-Second street, New York.

AIR-MAZE AIR FILTERS.—The Air-Maze Corporation, 812 Huron Road, Cleveland, Ohio, is distributing its 1937 catalog of Air-Maze industrial air filters for application on Diesel, semi-Diesel, gas and gasoline engines; air compressors; air-conditioning systems, etc. A four-page folder describes Air-Maze filters for railroad use.

"HANDBOOK OF COMMON MACHINE FASTENERS."—The Handbook of Common Machine Fasteners issued by The Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, N. Y., consists of 20 pages of a size to fit into the average drawing instrument case. It illustrates the method of drawing various types of bolts, nuts and rivets and is intended for those interested in the proper designs of such products for drafting work.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, Railway Master Mechanic, and Boiler Maker and Plate Fabricator. Name Registered, U. S. Patent Office

AUGUST, 1937

Volume 111 *No. 8*

Locomotives:

Cars:

General:

Editorials:

Back Shop and Enginehouse:

Car Foremen and Inspectors:

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Subscriptions, including the Daily editions of the Railway Age, published in June in connection with the convention of the Association of American Railroads, Mechanical Division, payable in advance and postage free. United States, U. S. possessions and Canada: 1 year, $3; 2 years, $5. Foreign countries, not including daily editions of the Railway Age: 1 year, $4; 2 years, $7. Single copies, 35 cents. Address H. E. McCandless, circulation manager, 30 Church street, New York.

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RAILWAY MECHANICAL ENGINEER

Two of the 900-hp. units operating in multiple on a test run

Birmingham Southern Installs Five

900-Hp. Diesel Switchers

Designed for heavy transfer work and multiple operation as 1,800-hp. units when desired. Prime movers are standard Alco 600-hp. engines with superchargers

LATE in March of this year the Birmingham Southern placed five Diesel-electric transfer switching locomotives in service which were built at the Schenectady plant of the American Locomotive Company. Each of the five units is equipped with a supercharged Alco railway-type engine supercharged to develop 900 hp. Inasmuch as the service for which these units were built makes it desirable to operate two of them as 1,800-hp. switchers they are equipped with multiple control. The overall length of each single unit is 43 ft. 3 in.; the total weight, 230,000 lb., and the maximum starting tractive force, 69,000 lb. The locomotives are designed for a maximum speed of 60 m.p.h.

Mechanical Equipment

The underframe is constructed of heavy plate and sections welded together. The particular feature of this underframe is the heavy center or backbone section, especially designed for withstanding heavy shocks and collisions. The operating cab is located at one end, while the hood construction is kept as narrow as possible, giving maximum visibility along the track.

The control stand is conveniently arranged on the right side of the operator's cab. All control switches, throttle and air-brake levers are mounted in this one unit, giving a clean appearance and a general absence of piping. The doors are of heavy steel plate. Side windows are suitably located for the engineman. All operating details within the cab have been carefully laid out, primarily based on steam-locomotive practice, which has been determined by the trial-and-error method over a period of many years of operation. The seats and arm rests are suitably upholstered to give the engineman and fireman the utmost in comfort.

The fuel tank is located underneath the operating cab and contains 500 gallons, which is ample for general operating conditions. Sand boxes having ample capacity are provided both front and rear. A feature in the operating cab is the use of electric heaters which give full output regardless of engine speed or temperature of cooling water. The Diesel engine is started by pushing in a small button on the control stand which throws the current from a heavy-duty battery across the main generator, thereby electrically starting the engine.

Trucks

The power trucks, two in number, are of the four-wheel center-bearing type, having a special design of cast-steel bolster. Single, long, semi-elliptic springs, one suspended by hangers in each side-frame casting, carry the load. Each truck equalizer, or what in this case may more properly be termed the side frame, is a steel casting at each end of which is the truck-box pedestal. The bolster casting is designed to form the nose mounting for the two traction motors on each truck and two brake cylinders are mounted outside of the

springs. The ends of the longitudinal side extensions of this casting carry vertical wearing pads bearing against similar pads on the side frames just inside the truck boxes. These keep the truck square in horizontal alignment without interfering with vertical flexibility.

The principal feature of this truck is that the construction provides for positive equalization at all times without the distortion of any truck members regardless of any uneven track condition. The low side frames and absence of end frames allow ready accessibility to the inspection covers and oil reservoirs of the traction motors. The brake rigging is all placed on the outside of the truck so that brake adjustments, inspection and brake-shoe renewals can be made with a minimum loss of time.

The axles are of open-hearth forged steel finished for truck and motor bearings, wheel and gear fits, and the journals are 8 in. by 14 in. The rolled-steel wheels are 40 in. in diameter.

Diesel Engines and Supercharger

The Alco 900-hp. Diesel engine is, from the standpoint of dimensions as well as maintenance, the same as the Alco 600-hp. engine, but includes a supercharger. The American Locomotive Company has found that this engine can be converted to produce a maximum of 1,200 hp. simply by adding a supercharger and slightly modifying certain features of the engine, such as the camshaft timing, compression ratio and the exhaust and intake manifolds. The supercharger on these engines is the result of five years of development work on the part of the American Locomotive Company in adapting a turbo-blower originally designed and built jointly by Dr. Buchi, a consulting engineer, and Brown, Boveri & Co., Ltd., to the Alco standard 600-hp. locomotive Diesel engine.

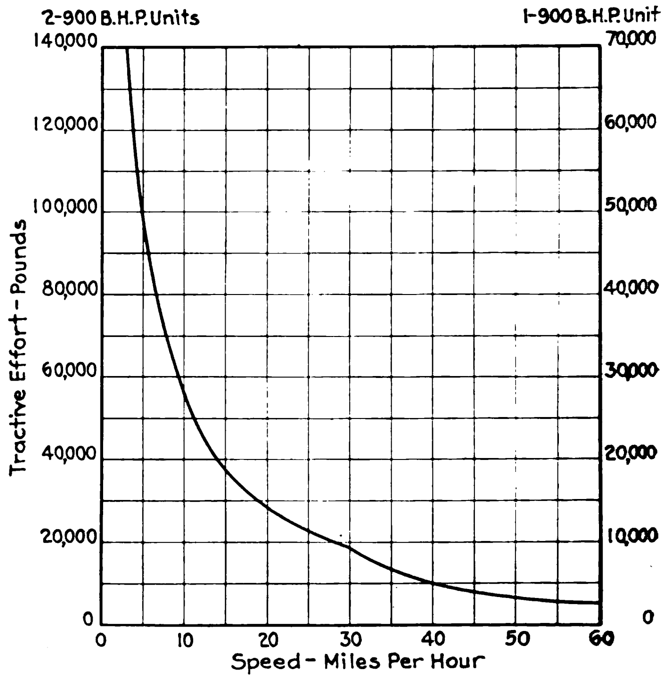
Table I — General Dimensions of Birmingham Southern Locomotives

	900 hp. (One unt)	1,800 hp. (Two units in multiple)
Length overall, ft. and in.	43-3	86-6
Width overall, ft. and in.	10-0	10-0
Height from rail (max.), ft. and in.	14-8½	14-8½
Wheel base, rigid, ft.	8-0	8-0
Wheel base, total, ft. and in.	28-6	72-6
Truck wheels, diameter, in.	40	40
Total weight locomotive, lb.	230,000	460,000
Weight on drivers, lb.	230,000	460,000
Starting tractive force, lb.	69,000	138,000
Maximum speed, m.p.h.	60	60
Minimum radius curvature, locomotive alone, ft.	50	90

After changing over the standard 600-hp. locomotive engine the operation is as follows: When the engine is idling the exhaust gases pass out of the cylinders into the exhaust manifold, which is actually in two parts, each part taking care of three cylinders. These gases then pass into the turbine side of the supercharger and through the turbine, revolving it at approximately 3,000 r.p.m. The exhaust gases, after going through this single stage row of turbine blades, then go directly up and out to the atmosphere. On the same shaft with the turbine is also mounted a turbo blower. This centrifugal-type blower draws air in through a specially designed filter and forces it into the intake manifold. The supercharger is, in effect, mounted in place of the muffler and, while the exhaust gases are coming out of one cylinder through the turbine, the blower is forcing pure air under pressure into another cylinder, the timing of which is handled by the cam shaft.

When the engine throttle is open and the governor set for a higher engine speed, more exhaust gases are produced and under a higher pressure, although only slightly above atmospheric pressure. The increased exhaust-gas volume in turn produces additional power in the turbine, which automatically speeds up the turbine and thereby pulls in more air, forcing it under a higher pressure into the intake manifold and then into the proper cylinders. When the engine is operating at full speed (700 r.p.m.) and full rated load (900 hp.) the supercharger is revolving at approximately 12,000 r.p.m. It is possible to operate at this high speed as there are no wearing parts in the supercharger except two bearings, one mounted on either end of the shaft.

The speed of the supercharger is entirely independent of engine speed and simply depends upon the amount of exhaust gases forced into it. This exhaust gas is forced in under a pressure of one or two pounds, while the blower forces the air into the engine under a pressure of two to four pounds. This method of supercharging completely scavenges the cylinder and cleans out any impure exhaust gases left in it. This is due to the fact that the intake valves are open just before the exhaust valves are closed. After the exhaust valves close the piston, on its way down, does not suck in air but the



Speed-tractive force curves for the Birmingham Southern locomotives operating singly and in pairs

supercharger forces the air in, so that there is a slight pressure on the top of the piston as it is on its way down. After the piston has reached the bottom of its intake stroke the intake valve closes, the result being that more air has been enclosed within the combustion chamber than would be the case without the supercharger. The piston then comes up on its compression stroke and, because of the increased amount of air, more fuel oil must be injected in order to obtain the proper ratio of fuel oil and air. This results in an increase of power. After the piston has been forced to the bottom of the stroke the exhaust valve is open and, as the piston comes up, it forces the exhaust out through the exhaust pipe into the turbine side of the supercharger. Through exhaustive tests it has been found that this increase of power does not produce an increase in the maximum pressures exerted upon the bearings, but simply produces an increase in the average pressures, giving a considerably higher mean effective pressure but not any higher max-

imum pressure. This is partly due to the fact that the air blown into the cylinder not only forces more air into this cylinder but also cleans out the cylinder. The resultant expansion within the cylinder deals entirely with pure air having a relatively slow, even-burning effect, rather than with air partly mixed with impurities, as the case in engines not supercharged.

Electrical Equipment

The electrical equipment consists primarily of Westinghouse main and auxiliary generators and traction motors, together with the various auxiliary units. The main and auxiliary generators are overhung from the engine and directly bolted by a solid coupling to the main engine shaft. The main generator delivers its entire output to the traction motors and is especially designed for heavy transfer service. The auxiliary generator is of the constant-voltage type (125 v.), maintaining voltage irrespective of engine speed. The auxiliary generator furnished current for the charging of the 56-cell heavy-duty starting battery, as well as the power to the auxiliaries, which include air compressors, radiator fan motor, traction-motor blower motor, fuel booster pump and cab heaters.

There are four single-geared commutating-pole-type traction motors, each supported on a truck axle, to assure the gear and pinion alignment, and on the truck bolster by means of a motor-nose spring support. The motor losses, particularly at high tractive forces, are relatively low per horsepower input.

The entire control of the locomotive is embodied in the operator's throttle which simply regulates the speed of the Diesel engine. Reversal is effected by a seperate lever operating a master controller. The motors are operated in series at low speed and are automatically changed by a voltage relay to series parallel and again automatically changed to field shunt for high locomotive speeds. When locomotives are being operated in multiple, all controls are handled at one control stand. The other control stand in the other units is locked and does not function, but the controls on that unit function in synchronism with the controls on the unit on which the operator is located.

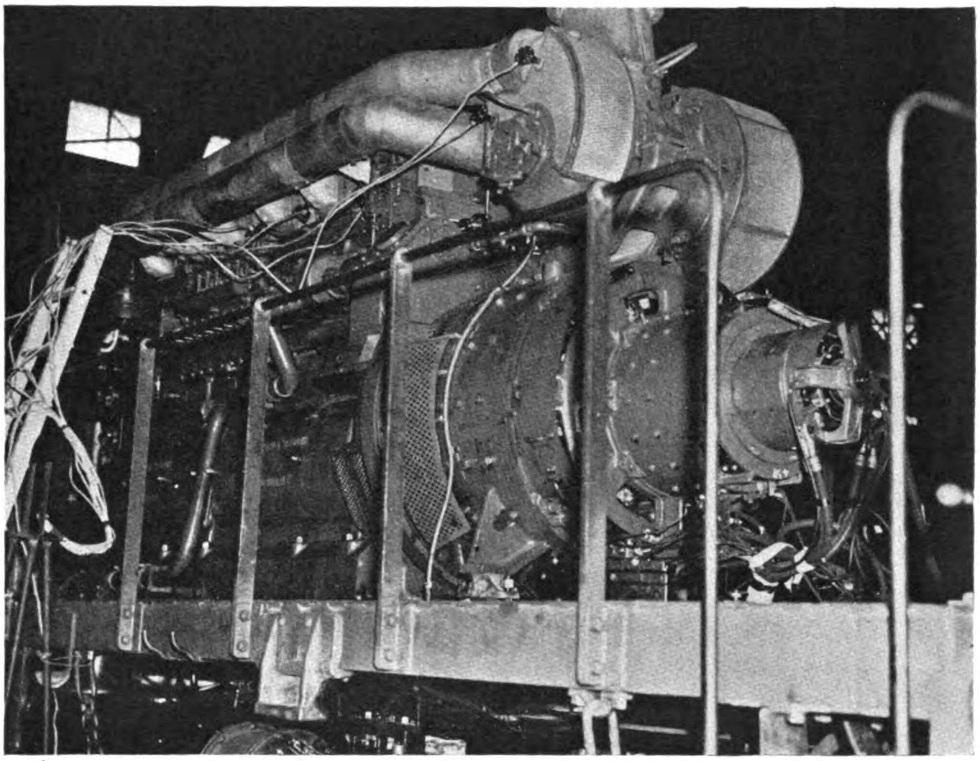
Conclusion

The locomotives are equipped with air-operated horn, fire extinguisher, meters, etc. A special feature includes placing the handrail on the extreme sides of the runway of the locomotive, allowing the engineman and fireman freedom to walk along the hood of the locomotive when in operation. By reducing the width of the hood as much as possible to increase visibility along the track, extra width is provided in the walkway.

Two Westinghouse D-4-P air compressors are used to give a total of 100 cu. ft. per min. regardless of whether the Diesel engine is idling or operating at full speed. The air reservoirs are of exceptionally large capacity, containing 72,500 cu. in. Four air-brake cylinders, 12 in. by 10 in., are used. These cylinders are mounted on each side of each truck, taking care of equalization of braking entirely through air pipes. Automatic and straight-air brakes are used, operated through Schedule EL-14 equipment.

The fuel consumption of these locomotives is approximately 8 gallons per hour, which, of course, varies, depending upon the amount of work performed, between 6 and 12 gallons per hour. The lubricating-oil consumption of these locomotives is not exceeding the lubricating-oil consumption of the Alco 600-hp. locomotive.

It is said that the exhaust temperatures on the 600-hp. engine when supercharged and delivering 900 hp. is slightly less than when the same engine is not supercharged. Therefore, since the engine temperature is one of the factors affecting the life of Diesel engines, it is expected that the maintenance cost of this supercharged engine will be no greater than for the same engine not supercharged. The only additional maintenance cost expected is that for the supercharger itself, which on foreign installations has given long service and has required inspection but once each year.



The power plant undergoing shop tests—The supercharger is seen above the main generator

Tentative Programs of

Mechanical Associations

Several of them meet in Chicago, the latter part of next month, with an extensive joint exhibit in the Hotel Sherman

All of the mechanical-department associations faced serious difficulties during the depression. Some of them made little or no effort to hold annual meetings, while others struggled along, dropping some of their meetings and holding others of a small and limited nature. As business in general has improved and railroad traffic has increased, it has been recognized by higher executive officers as well as by the officers of the associations, themselves, that it would be well to revive and re-establish them on a sound basis.

While these mechanical associations do not have the responsibility for developing standards and recommend practices which are made official by the Association of American Railroads, they do have a very large influence in improving the efficiency and effectiveness of the mechanical department, by acting as clearing houses for the best information concerning the practices of the various highly specialized and important groups which they represent. The necessity for such associations under normal conditions has always been recognized, but it is particularly pressing at the present time, when emerging from the depression finds the railroads with many foremen, supervisors and officers who have been elevated to their positions during the past few years and have not had the opportunities for broader contacts that were available to their predecessors. Coming together in annual meetings, with an exhibit showing the latest developments in their respective fields, these men are much better equipped to administer their departments effectively than if they remain isolated and do not have an opportunity of comparing notes and discussing their problems with men engaged in like work, on other parts of their own road or on other railroads.

The officers of the Mechanical Division have apparently felt that there was a possibility that some of the mechanical associations had either outlived their usefulness or that their purposes could be better carried forward by having some of them consolidate. Four of the associations are definitely committed to conventions in September. These include the Railway Fuel and Traveling Engineers' Association, the Car Department Officers' Association, the International Railway General Foremen's Association and the Master Boiler Makers' Association. The International Railway Master Blacksmiths' Association has decided not to hold a convention this year, and there is still some question as to whether the American Railway Tool Foremen's Association will meet.

A committee which was appointed to study the coordination of the various mechanical associations and which was responsible for bringing about the consolidation of the Traveling Engineers' and the Fuel Associations, has accomplished one other objective which has been in the minds of many people for a long time. It has arranged, with the approval of the Mechanical Division, to have these associations meet in Chicago in the same hotel and within a period of four days, with a joint exhibit, thus relieving the railway supply manufacturers of the expense of making separate exhibits for the different associations, as was the practice when they met at different times and at different places.

Naturally, with the difficulties and changes in personnel in some of the associations, the problem faced by those in charge of the preparation of the programs for the September meetings has not been an easy one. These programs are not complete as we go to press with this number, but in order that mechanical-department representatives may have some idea of what is proposed and may make arrangements to attend these meetings, the following tentative programs are presented, with the understanding that they are in the course of building and may be changed in some respects before the time of the meetings.

Car Department Officers' Association

Gray Room, Hotel Sherman
September 28-29

The Car Department Officers' Association only adopted that name at a meeting held in Detroit, Mich., August 26-28, 1930, and so has not had much of an opportunity to make a record under the new designation. Its predecessors, however, had long and honorable careers. In 1930 its name was changed from Master Car Builders' and Supervisors' Association, which association was the result of a consolidation in 1928 of the Railway Car Department Officers' Association and the Southwest Master Car Builders' and Supervisors' Association. It dates back to 1898, when the Chief Interchange Car Inspectors and Car Foremen's Association was organized.

It will hold a two-day meeting September 28-29. The program given below is tentative. Definite acceptances have not yet been received from all of those who were invited to take part in the program. With this reservation, the program as presented must be taken in the light of what the officers have in mind in a large way, rather than for accuracy in detail.

September 28

Morning Session, 10:00 A.M.

Address by President K. F. Nystrom, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific.

Address by a representative of the Association of American Railroads.

Address by R. V. Wright, editor, *Railway Mechanical Engineer*.

Report of Nominating Committee.

Afternoon Session, 2:00 P.M.

Address by C. J. Nelson, superintendent interchange, Chicago Car Interchange Bureau.

Address by W. L. Ennis, manager refrigeration and freight claim prevention, Chicago, Milwaukee, St. Paul & Pacific.

September 29

Morning Session, 9:30 A.M.

Address by J. T. Gillick, chief operating officer, Chicago, Milwaukee, St. Paul & Pacific.
Address by LeRoy Kramer, vice-president, General American Transportation Corporation.
Address by A. F. Stuebing, railway mechanical engineer, United States Steel Corporation.

Afternoon Session, 2:00 P.M.

Address by W. J. Patterson, chief, Bureau of Safety, Interstate Commerce Commission.
Report of A.A.R. Committee.

The officers of the association are President, K. F. Nystrom, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis.; first vice-president, F. A. Starr, superintendent reclamation, Chesapeake & Ohio, Covington, Ky.; second vice-president, E. J. Robertson, superintendent car department, Minneapolis, St. Paul & Sault Ste. Marie, Minneapolis, Minn.; third vice-president, C. J. Nelson, superintendent of interchange, Chicago Car Interchange Bureau, Chicago; fourth vice-president, A. J. Krueger, master car builder, New York, Chicago & St. Louis, Cleveland, Ohio; secretary-treasurer, A. S. Sternberg, master car builder, Belt Railway of Chicago, Clearing, Ill.

General Foremen's Association

Rose Room, Hotel Sherman
September 28-29

The International Railway General Foremen's Association, because of the illness and retirement of its secretary, William Hall, who functioned so acceptably in that capacity for many years, has faced special difficulties in building up its program. Matters are now well in hand, however, and excellent progress has been made in whipping into shape what promises to be a practical and inspiring program.

The two-day meeting will be held on Tuesday, September 28, and Wednesday, September 29. Because final acceptances have not yet been received in all instances, the names of those who are scheduled to make the addresses are omitted, but will appear in the September number of the *Railway Mechanical Engineer*. The program is as follows:

Tuesday, September 28

Morning Session

Opening ceremonies.
Address: How Can the Mechanical Supervisor Be of Greater Help to the Railroad Management?
Appointment of committees.
Address: How Long Can We Put Off Training Men, Both Mechanics and Supervisors?

Afternoon Session

Open Forum: This will be a three-hour forum discussion of questions pertinent to the locomotive back shop, enginehouse and passenger- and freight-car problems. Among the topics already listed are Controlling Waste, Winning Co-operation, Maintenance of Special Equipment on Locomotives, Care and Maintenance of Shop Tools, Improved Work Methods, and Maintenance of Freight Equipment. Suggestions are still coming in from members of the association.

Wednesday, September 29

Morning Session

Address: Mechanical Supervisors and Public Opinion.
Address: Modern Methods in Freight-Car Building and Repair.

Afternoon Session

Address: Can Modern Machine Tools Cut Repair Costs?
Address: Handling Safety Problems in the Shop.

The officers of the association are President, F. T. James, general foreman, Delaware, Lackawanna & Western, Kingsland, N. J.; first vice-president, F. B. Downey, assistant shop superintendent, Chesapeake & Ohio, Huntington, W. Va.; second vice-president, J. W. Oxley, general car foreman, Chicago & North Western, Proviso, Ill.; and third vice-president, C. C. Kirkhuff, general foreman, Atchison, Topeka & Santa Fe, Corwith, Ill.

Master Boiler Makers' Association

Crystal Room, Hotel Sherman
September 29-30

The Master Boiler Makers' Association made an unusual effort during the depression to carry on its activities and succeeded unusually well, all things considered. The president, M. W. Milton, is chief boiler inspector, Canadian National Railways, Toronto, Ont.; it is quite fitting therefore, that C. C. Stibbard, chief operating officer of the Board of Railway Commissioners for Canada, has been asked to address the association.

In addition to reports from the standing committees, the National Electrical Manufacturers' Association has accepted an invitation to present a paper on metallic arc welding, and the International Acetylene Association has likewise agreed to present a paper on the use of acetylene in the fabrication of boilers and tenders. The Water Service Committee of the American Railway Engineering Association has also agreed to discuss the report on pitting and corrosion of boilers and tenders.

The committees which will make reports at the September meeting include the following:

Topic No. 1—Pitting and Corrosion of Locomotive Boilers and Tenders. Louis R. Haase, chairman, district boiler inspector, Baltimore & Ohio, Glenwood, Pa.; J. L. Callahan, service engineer, National Aluminate Corporation, Chicago; John J. Powers, system boiler foreman, Chicago & North Western, Oak Park, Ill.; Albert W. Novak, general boiler inspector, C. M. St. P. & P., Milwaukee, Wis.; Frank Yochem, general boiler inspector, Missouri Pacific, St. Louis, Mo.

Topic No. 2—Autogenous Welding and Cutting as Used in the Fabrication of Boilers and Tenders. Albert F. Stiglmeier, chairman, general boiler foreman, New York Central, West Albany, N. Y.; John A. Doarnberger, master boilermaker, Norfolk & Western, Roanoke, Va.; Gay E. Stevens, boiler supervisor, Boston & Maine, Malden, Mass.; James A. McGraulty, general foreman boiler department, American Locomotive Company, Schenectady, N. Y.

Topic No. 3—Proper Thickness for Front Tube Sheets. Walter R. Hedeman, chairman, assistant mechanical engineer, Balti-

more & Ohio, Baltimore, Md.; T. H. Moore, general boiler inspector, Western Maryland, Hagerstown Md.; Carl A. Harper, general boiler inspector, C. C. C. & St. L., Indianapolis, Ind.; E. C. Umlauf, supervisor of boilers, Erie, Jersey City, N. J.; and William Henry general boiler inspector, Canadian Pacific, Calgary, Alta.

Topic No. 4—Improvements of Safe Ending and Application of Flues and Tubes. Frank A. Longo, chairman, welding and boiler supervisor, Southern Pacific, Los Angeles, Cal.; Sigurd Christopherson, supervisor of boilers and maintenance, N. Y. N. H. & H., East Milton, Mass.; E. H. Gilley, general boiler inspector, Grand Trunk, Battle Creek, Mich.; J. M. Stoner, supervisor of boilers New York Central, Cleveland, Ohio; and Carl F. Totterer, general boiler foreman, Alton, Bloomington, Ill.

Topic No. 5—Improvements to Prevent Cracking of Firebox Sheets Out of Staybolt Holes. C. W. Buffington, chairman, general master boilermaker, Chesapeake & Ohio, Huntington, W. Va.; V. H. Dunford, general master boilermaker, Seaboard Air Line, Norfolk, Va.; R. M. Cooper, district boiler inspector, Baltimore & Ohio, Cincinnati, Ohio; H. E. May, general boiler and locomotive inspector, Illinois Central, Chicago; George L. Young, boiler department foreman, Reading, Reading, Pa.

Topic No. 6—What Is Being Done to Prevent Back Tube Sheets from Cracking in Radius of Flange and Out of Tube Holes. Louis Nicholas, chairman, general boiler foreman, Chicago, Indianapolis & Louisville, La Fayette, Ind.; G. E. Burkholtz, general boiler inspector, St. Louis-San Francisco, Springfield, Mo.; H. A. Bell, general boiler inspector, Chicago, Burlington & Quincy Lincoln, Neb.; and E. E. Owens, general boiler inspector, Union Pacific, Lincoln, Neb.

Topic No. 7—Topics for 1938 Meeting. George M. Wilson, chairman, general boiler supervisor, American Locomotive Company, Schenectady, N. Y.; W. H. Keiler, locomotive inspector, Interstate Commerce Commission, Omaha, Neb.; Ira J. Pool, boiler-tube expert, National Tube Company, Baltimore, Md.: Leonard C. Ruber, superintendent boiler department, Baldwin Locomotive Works, Darby, Pa.; George B. Usherwood, supervisor of boilers, New York Central, Albany, N. Y.

Topic No. 8—Law. Myron C. France, chairman, general boiler foreman, C. St. P. M. & O., St. Paul, Minn.; Kearn E. Fogerty, general boiler foreman, Chicago, Burlington & Quincy, Chicago; and L. M. Steeves, foreman boiler department, Chicago & Eastern Illinois, Danville, Ill.

The officers of the association are: President, M. V. Milton, chief boiler inspector, Canadian National Railways, Toronto, Ont.; vice-president, W. N. Moore, general boiler foreman, Pere Marquette, Grand Rapids, Mich.; and secretary-treasurer, A. F. Stiglmeier, boiler department foreman, New York Central, 29 Parkwood Street, Albany, N. Y.

Railway Fuel and Traveling Engineers' Association

Grand Ballroom, Hotel Sherman
September 28—October 1

This association was formed last September and is a combination of the Traveling Engineers' Association and the International Railway Fuel Association. Each of these associations made an excellent record in the past and was noted because of the high calibre of the addresses and reports which were made each year. The convention will extend over four days, Tuesday, September 28, to Friday, October 1, inclusive.

The meeting on the first day will be featured with an address by M. J. Gormley of the Association of American Railroads. Most of the time of the two sessions, on this day, however, will necessarily be given over to matters of organization, since this is the first meeting of the new association.

For the convenience of the members in planning to attend the convention and for those who may not be able to remain throughout, the programs for the following three days have been grouped under a "Mechanical Day," "Air Brake Day" and "Fuel Day." It is planned to adjourn early in the afternoon, as near four o'clock as possible, on each of the first three days, in order that the members may have an opportunity of thoroughly studying the exhibits.

The tentative program follows, the times given, of course, being approximate.

Tuesday, September 28

10:30 a.m.—Convention opens.
10:35 a.m.—Invocation by Dr. Bertram G. Jackson.
10:45 a.m.—Chairman's Address, by J. D. Clark, fuel supervisor, Chesapeake & Ohio.
11:00 a.m.—Address by M. J. Gormley, executive assistant to president, Association of American Railroads.
11:30 a.m.—Report of Committee on Constitution and By-Laws, presented by R. Collett, fuel agent, St. Louis-San Francisco.
2:00 p.m.—Election of officers.
Adjourn to view exhibits.

Wednesday, September 29

MECHANICAL DAY

9:30 a.m.—Report of Committee on New Locomotive Economy Devices, presented by A. G. Hoppe, assistant mechanical engineer, Chicago, Milwaukee, St. Paul & Pacific.
10:15 a.m.—Report of Committee on Steam Turbine and Steam Condensing Locomotives, presented by L. P. Michael, chief mechanical engineer, Chicago & North Western.
11:00 a.m.—Address by Walter H. Flynn, general superintendent motive power and rolling stock, New York Central Lines.
11:30 a.m.—Report of Committee on Front Ends, Grates and Ash Pans, presented by Prof. E. C. Schmidt, University of Illinois.
2:00 p.m.—Report of Committee on Attention to Valve Motion and Its Effect on Fuel Economy, presented by M. F. Brown, fuel supervisor, Northern Pacific.
3:00 p.m.—Report of Committee on Utilization of Locomotives, presented by A. A. Raymond, superintendent fuel and locomotive performance, New York Central Lines.
Adjourn to view the exhibits.

Thursday, September 30

AIR BRAKE DAY

9:30 a.m.—Report of Committee on Air Brakes, presented by W. H. Davies, superintendent air brakes, Wabash Railway.
11:00 a.m.—Address by L. K. Sillcox, vice-president, New York Air Brake Company.
2:00 p.m.—Report of Committee on Locomotive Firing Practice—Oil, presented by R. S. Twogood, assistant engineer, Southern Pacific Company.
Report of Committee on Locomotive Firing Practice—Coal, presented by W. C. Shove, general road foreman of engines, New York, New Haven & Hartford.
Adjourn to view the exhibits.

Friday, October 1

FUEL DAY

9:30 a.m.—Report of Committee on Subjects.
10:00 a.m.—Address by Eugene McAuliffe, president, Union Pacific Coal Company.
10:45 a.m.—Report of Committee on Inspection, Preparation and Utilization of Fuel, presented by W. R. Sugg, superintendent fuel conservation, Missouri Pacific.
11:15 a.m.—Report of Committee on Fuel Records and Statistics, presented by E. E. Ramey, fuel engineer, Baltimore & Ohio.

11:35 a.m.—Report of the Secretary-Treasurer, T. Duff Smith.
12:00 m. —Report of Finance Committee.
12:15 p.m.—Other business.
2:00 p.m.—The entire afternoon will be available for visiting the exhibits.

The officers of the association are: President, J. D. Clark, fuel supervisor, Chesapeake & Ohio, Richmond, Va.; vice-chairmen, C. I. Evans, chief fuel supervisor, Missouri-Kansas-Texas, Parsons, Kan.; A. T. Pfeiffer, road foreman of engines, New York Central, Syracuse, N. Y.; and F. P. Roesch, vice-president, The Standard Stoker Company, Inc., Chicago, Ill.; and secretary-treasurer, T. Duff Smith, 1255 Old Colony Building, Chicago, Ill.

Large Exhibit Planned by Railway Supply Companies

September 28—October 1

It is planned to provide an unusually large and comprehensive exhibition of railway equipment and supplies, a study of which will prove an important supplement to information secured by railroad men in their respective technical sessions.

Owing to the fact that the mechanical associations have arranged to hold simultaneous sessions at a central city like Chicago, which can conveniently be reached from all points in the West and Middle West, it is anticipated that the attendance of mechanical department officers, and especially those in the lower ranks, will actually exceed the total attendance of railroad men at the Atlantic City convention in June.

The exhibition of railway locomotive and car equipment and supplies will be very extensive in scope, about 40,000 sq. ft. of exhibition space being available in the exhibit hall and on the mezzanine and lobby floors of the Hotel Sherman. The indications are that about 150 manufacturers and distributors will take advantage of this opportunity to exhibit their products to mechanical-department officers of all ranks, and particularly those in the lower brackets, many of whom, while keenly interested in the performance of railway mechanical materials and specialties, were unable to attend the Atlantic City convention. At least 45 manufacturers and supply companies have already signed up for exhibition space.

The railway exhibit at the Hotel Sherman in September is being sponsored by the Allied Railway Supply Association, Inc., which consists of the following: Air Brake Appliance Association; Association of Railway Supply Men, associated with the International Railway General Foremen's Association; Boiler Makers' Supply Men's Association; International Railway Blacksmiths' Supply Association; Railway Fuel and Traveling Engineers' Supply Association; the Supply Men's Association, associated with the Car Department Officers' Association.

The officers of the Allied Railway Supply Association, Inc., are: President, E. S. Fitzsimmons, Flannery Bolt Company, Bridgeville, Pa.; first vice-president, L. B. Rhodes, Vapor Car Heating Company, Washington, D. C.; second vice-president, J. W. Fogg, MacLean-Fogg Lock Nut Company, Chicago; third vice-president, C. F. Weil, American Brake Shoe & Foundry Company, Chicago; fourth vice-president and assistant treasurer, Fred Venton, Crane Company, Chicago; fifth vice-president, M. K. Tate, Lima Locomotive Works, Inc., Lima, Ohio; sixth vice-president, H. S. Mann, Standard Stoker Company, Inc., Chicago; secretary J. F. Gettrust, Ashton Valve Company, Room 1108 New Post Office, Chicago; treasurer, G. R. Boyce, A. M. Castle & Company, Chicago.

Railway

Equipment Trends

The relative advantages of steam, Diesel and electric motive power are discussed, in the Report of the National Resources Committee. Relation of improvements in car design to increased traffic is also considered

ONE part of the National Resources Committee's report, recently submitted to President Roosevelt by the chairman of the committee, Harold L. Ickes, dealt with "Technological Trends and National Policy." This included a section on transportation prepared by Harold A. Osgood, vice-president of the Fulton Iron Works Company, St. Louis, Mo., with the assistance of the National Resources Committee's special committee on transportation, of which Frederic A. Delano served as chairman.

In that part devoted specifically to railway transportation much discussion is included as to the relative advantages of steam power, Diesels and electrification. The latter is called "the result of necessity rather than desire," its justification resting "far more on density of traffic than on any other factor . . . only with a large volume of business can enough operating expenses be saved to justify the increased capital charges." Also, "railroads directly serving coal mines and those whose tonnage is largely coal will not be eager to electrify as a matter of general business policy, though so great a coal carrier as the Pennsylvania has been forced to do so by special conditions." From its next observation that electrification will be confined in the main to "extremely dense traffic areas" the report goes on to list as possibilities in this connection the New York, New Haven & Hartford's line between New Haven, Conn., and Boston, Mass., and the main line of the

New York Central—although, in the latter case, "it seems improbable that the necessity for such action will arise in the next 10 or 15 years."

Of the Diesel the report says that despite their high thermal efficiency their advantages as compared with steam locomotives "for road passenger service remain to be demonstrated." Continuing, it observes that advantages claimed for the Diesel "are today largely nullified by high investment costs and fixed charges." It adds, however, that "even today the Diesel electric has many advantages in terminal service, and in that field probably lies the Diesel's best chance in the near future."

Steam Locomotive Will Hold Its Own

Turning to the steam locomotive Mr. Osgood predicts that the bulk of railroad freight will continue to be hauled by that type of motive power; and he adds that "considering the many years of research and practical experience back of steam engineering, and the cumulative and accelerating progress in this art, this is to be expected." He goes on to deny that his prediction implies "any lack of progress," for "few types of machinery have been so greatly improved in the past 20 years as steam locomotives." Even for light streamlined trains, "where popular demand seems to be for novel shapes and colors of motive power, the reciprocating steam locomotive, considering particularly its cost, offers about as much promise as the Diesel."

Freight Cars

With two million freight cars in service Mr. Osgood thinks "it is plain that changes in this class of equipment can only be made slowly." But for the development of the motor truck he believes we might have followed British practice and built small cars. However, with the traffic adapted to such equipment now largely lost to the truck, Mr. Osgood observes that "we may anticipate neither radical nor rapid changes in our freight equipment." He does believe that "a good deal can yet be done toward reducing weight, both through changes in car design and the substitution of lighter materials." The savings, however, "will be largely confined to the item of fuel, and fuel costs are now on such a low gross ton-mile basis that any car having a higher first cost will have difficulty in justifying itself."

Also, the report predicts that a new form of freight car will be worked out to carry either truck bodies or containers; but "its ultimate development waits on the determination through experience as to which of these forms of rail-and-truck co-ordinated transportation is most satisfactory. It seems unlikely that both will have a place."

Passenger Equipment

Of passenger equipment the report states that air conditioning has had a wider appeal to the traveling public than any other single development since the introduction of the steel car. Also, streamlining, "at least in appearance," is demanded by the public. Yet, the report goes on to say that the benefits of streamlining to the railroad "are generally much less than is commonly believed"; but along with bright colors it catches "the public eye and fancy"—and both "are of undoubted benefit in advertising, if not in operation." Reduction of the cross section, Mr. Osgood says, has so far been of more tangible benefit than actual streamlining; but he adds that whether the traveling public will ultimately favor cars of less than conventional width and headroom "remains to be seen." He does find, however, that "reduction of passenger car weights and dimensions is a promising field." As one of the advantages of light passenger equipment the report cites low operating costs permitting more frequent service.

Results of Refrigerator-Car

Ice-Meltage Tests

By E. A. Gorman, Jr.*

U. S. Department of Agriculture develops drip-meter for determining ice meltage in refrigerator cars. Ice meltage calculated mathematically compared with drip-meter measurements obtained from tests

During the past 30 years or more the United States Department of Agriculture has been conducting investigations on the transportation of perishables and has often been called upon as a disinterested agency to study problems with which shippers and carriers have to deal.† The results of this work have been responsible in no small measure for many significant improvements in equipment and methods of shipment as well as for effecting economies in refrigeration and transportation costs and reducing spoilage in transit. This work therefore has been an important contributing factor in the growth of producing areas far removed from consuming centers and the consequent increase in perishable railway traffic resulting therefrom.

The extent and scope of the Department's work in this field is indicated by the record for the 12-month period from November, 1934, to October, 1935, inclusive. During this period the Bureau of Plant Industry of the United States Department of Agriculture conducted 24 major tests on rail shipments of apples, cantaloupes, grapes, lemons, oranges, peaches, pears, strawberries and lettuce. The studies were made not only on precooling and transit refrigeration but also on methods of protection against freezing during winter weather. Temperatures encountered in the course of these tests ranged from 47 deg. F. below zero to 117 deg. F. above zero.

The modified forms of transit refrigeration developed in the Department's work have proved entirely adequate and satisfactory in some classes of service and have re-

* Principal Scientific Aide, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industries, U. S. Department of Agriculture.

† These investigations are under the direction of D. F. Fisher, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture.

sulted in savings up to $40 or more per car, made up principally of savings in ice consumption. In seasons when returns are low such savings might conceivably represent the difference between profit and loss.

In the designing of new equipment and the development of icing methods for the transportation of perishable foodstuffs, measurement of ice consumption must be considered. Methods of accurately determining the rate of ice meltage during transit have not until recently been perfected to a point of reliability. It is the purpose of this article to describe briefly a method of accomplishing this which has been developed by the United States Department of Agriculture.

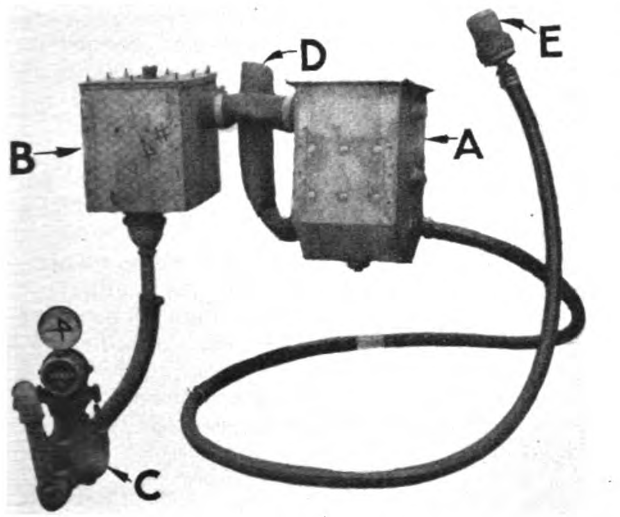


Fig. 1—The drip meter developed by the U. S. Department of Agriculture

Table I—Icing Data as Indicated by Weighing the Re-icing and by the Use of Drip Meter*

Day of test	Time of day	Total cumulative ice meltage indicated by: Meters	Re-icing	Re-icing variation from meter reading	Meltage between icings indicated by: Meters	Re-icing	Re-icing weight; variation from meter reading: Pounds	Per cent
1	3:55 a. m.†	0	0	0	0	0	0	0
1	3:55 p. m.	2,230	1,554	−676	2,230	1,554	−676	−30.0
2	12:00 m.	5,130	4,965	−165	2,900	3,411	+511	+17.6
3	5:00 a. m.	6,816	6,562	−254	1,686	1,597	−89	−5.2
3	4:00 p. m.	7,727	7,494	−233	911	932	+21	+2.3
4	6:15 a. m.	8,751	8,455	−296	1,024	961	−63	−6.1
4	10:00 p. m.	9,745	9,456	−289	994	1,001	+7	+0.7
5	7:00 p. m.	10,919	10,638	−281	1,174	1,182	+8	+0.6
6	7:15 p. m.	12,387	12,129	−258	1,468	1,491	+23	+1.5
7	7:15 a. m.	12,933	12,821	−112	546	692	+146	+26.7
8	2:15 a. m.	13,785	13,372	−413	852	551	−301	−35.3
8	11:00 p. m.	14,577	14,070	−507	792	698	−94	−11.8

* Test run made with a car load of Valencia oranges moved in ice-bunker refrigerator cars from Los Angeles, Calif., to New York, N. Y., June, 1936.

† Time of initial icing. Initial and all re-icing weights are actual scale weights of ice supplied.

Previously, the method used for determining the amount of ice used in the refrigeration of test shipments was either to weigh it when supplied to the cars or to measure the empty space above the ice in bunkers and calculate the meltage therefrom, the full capacity of the bunkers being known. When cars move under "standard refrigeration" it is possible to determine approximately the rate of ice meltage by the amount of ice required to refill the bunkers, which under this service is done periodically about once every 24 hrs. Due to various factors the error in such records has been found to vary as much as 35 per cent in indicating meltage between re-icings (see Table I) for intermediate portions of the test. For the total ice meltage during the entire trip, however, this method can be relied upon for transcontinental shipments when the ice remaining in the bunkers at destination is carefully determined. The method is not at all applicable, however, for determining the rate of ice meltage in cars moving without re-icing in transit.

It is desirable to ascertain the ice-meltage rate with shipments of different commodities, under varying climatic conditions encountered during different seasons of the year and in cars with different types of insulation and construction. The practical method developed by the Department for obtaining such records is that of measuring the ice water running out of the drain pipes. This has been attempted by various investigators during the past 20 years or more, but few of the "drip meters" developed ever reached the stage where they could be used for road tests.

Table II—Icing Conditions for Data in Fig. 2

Car	Month	Day initially iced	Day loaded	Commodity condition	Day re-iced
A	Aug.	First (C. I.)*	Second	Not precooled	Third & seventh
A	Oct.	First (C. I.)	Second	Not precooled	Third
B	Aug.	Third (C. I.)	Second	Not precooled	Sixth
B	Oct.	Third (C. I.)	Second	Not precooled	Seventh
C	Aug.	Second (B. I.)*	Second	Precooled	Not re-iced
C	Oct.	Second (B. I.)	Second	Precooled	Not re-iced

* C. I.—Chunk ice. B. I.—Block ice.

A new type of drip meter, shown in Fig. 1, was designed and tested by the author in 1934 at the Bureau of Plant Industry cold-storage laboratory, Arlington Farm, Va. Since then a number of these devices have been used with transcontinental test shipments. In these road tests a total of 199,880 lb. of ice was melted and the individual cars were moved over a total of 102,000 miles without any serious effect on the performance of the drip meters.

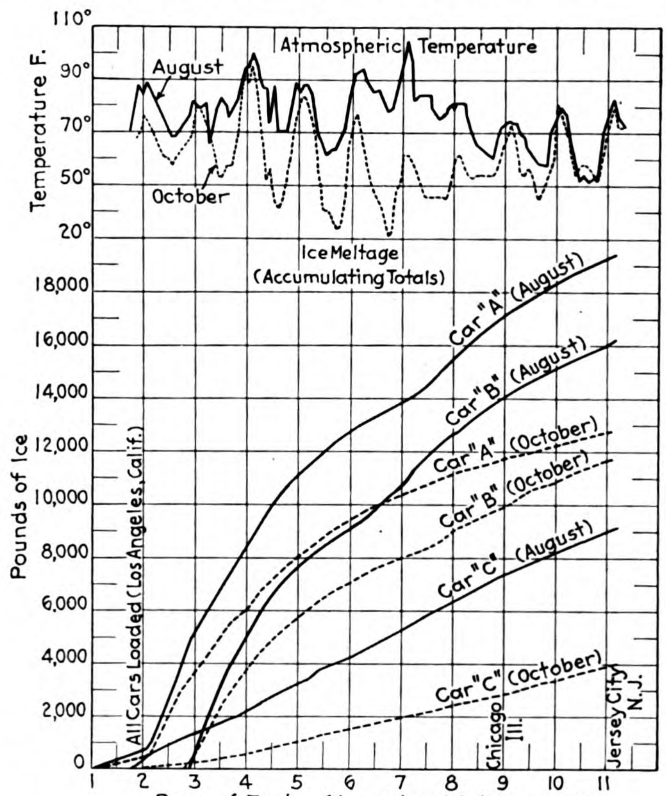


Fig. 2—Comparison of cumulative ice meltages of modified types of refrigeration in tests during August and October, 1935, with prevailing atmospheric temperatures—See Table II

The device is simple and rugged in construction and accurate in operation. As shown in Fig. 1, it consists of three parts: A filter and sediment collector *A*, an accumulating and flushing tank *B*, and a disc-type water meter *C*; *D* and *E* are hose connections to bunker drain traps. Two such devices are used per car, placed one at each end on opposite sides. Drip water from both drain pipes of the bunker is conducted to the filter tank of the meter by means of rubber hose arranged under the car end sills in a manner to avoid fouling any of the truck parts. The tanks of the metering unit are fastened to the car sills with metal strips and wedged between the side sill and the first intermediate sill of the car on the underside of the floor superstructure. The water meter is secured in a specially constructed stirrup bolted to the body bolster. All parts of the device are within the clearance limits of the particular car on which it is applied.

The water from the melting ice enters the filter or screening tanks where all foreign matter large enough to foul the working mechanism of the device is eliminated. The water then passes into an accumulating or flush tank and after rising to a sufficient height causes the operation of valves therein, releasing the stored water which runs out through the disc type water meter at a rate of flow sufficient to produce accurate registration.

In duplicate tests on orange shipments from California to New York City in August and October, 1935, ice-meltage records were obtained by means of the drip meters described. Average fruit temperatures were obtained by means of electrical resistance thermometers placed in strategic zones of the load. Outside air temperatures were obtained with mercury thermometers.

Fig. 2 presents some of the results obtained in these investigations and permits the correlation of ice meltage during any portion of the tests with outside air temperatures and temperatures inside the car.

It is believed that the device described will prove useful to many engineers who have occasion to make similar tests or to determine the relative efficiency of different cars. The drip meter is registered under Patent No. 2,057,234 and can be used by anyone securing license from the Secretary of Agriculture.

The arrangements by C. W. Mann of the U. S. Department of Agriculture at Pomona, Calif., for the transportation tests of the device described in this article, and the cooperation of the California Fruit Growers Exchange and the Pacific Fruit Express Company are hereby acknowledged.

Design Features of Lightweight

Modern Locomotive Equipment-I*

A discussion of the development and research problems involved in the design of Timken lightweight reciprocating and rotating parts for locomotives

THE steam locomotive represents the lowest first cost per horsepower of motive-power units, and this fact in addition to its reliability and versatility of power has made difficult its displacement by other forms of motive power. Lately, however, competition is requiring design modifications which are not in general use today if the steam locomotive is to meet the operating requirements at the ever-increasing high speeds in both freight and passenger service.

This paper discusses the development and research problems involved in such design modifications, and deals with the mechanical equipment of the steam locomotive. The general objects of such improvements for high-speed operation are to obtain (*a*) reduced dynamic augment on the rails due to rotating and reciprocating parts so that it will not be detrimental to the existing track structure; (*b*) improved movement of the locomotive over the track by reducing nosing and fore-and-aft vibrations, thereby reducing the forces and maintenance costs on locomotive parts and track structure; (*c*) increased availability; (*d*) reduced operating maintenance cost; (*e*) greater acceleration; (*f*) increased speeds; and (*g*) increased tractive force.

The Timken Roller Bearing Company has been dealing for years with the problems of obtaining these desired improvements in operating characteristics. Co-operation of various railroads in this development work has resulted in modifications in locomotive design incorporating the application of (*a*) lightweight reciprocating parts, including the piston, piston rod, and crosshead assembly; (*b*) lightweight main and side rods; (*c*) roller-bearing crosshead pins, main pins, side pins; (*d*) roller-bearing-equipped driver, trailer, engine- and tender-truck axles.

The beneficial results effected in locomotive operation through the application of Timken bearings to all axles are generally recognized. At the time of this writing, two main-line high-speed steam passenger locomotives have been in road service for some time with Timken lightweight revolving and reciprocating parts, including Timken-bearing-equipped crankpins and wrist pins. Service results have justified the extension of these applications to 53 additional locomotives now being built for various railroads, as indicated in Table I wherein locomotive specifications and road mileages are given. One of the applications is shown in Fig. 1.

The Importance of Lightweight Reciprocating Parts

The dynamic augment or hammer blow on the rail resulting from underbalance or overbalance of rotating parts increases with the square of the speed so that in going from 70 m.p.h. to 100 m.p.h., a speed increase of 41 per cent, twice the dynamic augment is produced. Considering that there are certain limiting combined

* Abstracted from a paper on "Modern Locomotive and Axle Testing Equipment," by T. V. Buckwater, O. J. Horger and W. C. Sanders, published in the Transactions of the American Society of Mechanical Engineers, April, 1937, and presented before the semi-annual meeting, Detroit, May 17-21, 1937.

Table 1—Comparison of Weights of Revolving and Reciprocating Parts, Dynamic Augment on Rail, and Maximum Horizontal Force on Locomotives Equipped with Plain-Bearing and Timken-Bearing Rods

Railroad	P. R. R.			N. Y. C.			U. P.			C. B. & Q.		
Type	4-6-2			4-6-4			4-8-2			4-6-4		
Class	K-4-s			J-1-E			MT-1			S-4		
Number of locomotives	1*			1†			1§			1§		
Cylinder size, in.	27 x 28			23¾ x 28			29 x 28			25 x 28		
Boiler pressure, lb. per sq. in.	205			250			200			250		
Driver diameter, in.	80			79			73			78		
	Plain	Timken	Per cent diff.	Plain	Timken	Per cent diff.	Plain	Timken	Per cent diff.	Plain	Timken	Per cent diff.
Revolving weight on pin, including crank pin, lb.: ¶												
Back	301	417	+39	298	441	+48	....‖	468	...	....‖	437	...
Intermediate	....	....	...	....	....	...	....	833	...	....	....	...
Main	1,435	1,195	−17	1,579	1,279	−19	....	1,510	...	....	1,305	...
Front	285	321	+13	320	362	+13	....	397	...	....	360	...
Total	2,021	1,933	− 4	2,197	2,082	− 5	....	3,208	...	....	2,102	...
Reciprocating weight per locomotive side:												
Total weight, lb.	1,473	977	−34	1,971	944	−52	2,012	1,083	−46	2,067	995	−52
Weight balanced on main, per cent	19.4	17.5	...	10.1	10.1	...	17.2	8.3	...	19.0	10.0	...
Total weight balanced, per cent	58.2	52.6	...	37.1	37.1	...	51.5	33.3	...	57.0	29.9	...
Unbalanced weight, lb.	615	464	−25	1,239	595	−52	976	723	−26	888	698	−21
Dynamic augment on rail at main wheel in 1,000 lb. for:												
60 m.p.h.	7.2	4.3	−40	5.2	2.5	−52	7.8	2.7	−65	10.4	2.6	−75
80 m.p.h.	12.8	7.7	−40	9.2	4.4	−52	13.9	4.9	−65	18.5	4.7	−75
100 m.p.h.	20.1	12.0	−40	14.4	6.8	−52	21.8	7.6	−65	29.0	7.3	−75
120 m.p.h.	28.9	17.3	−40	20.7	9.8	−52	31.4	10.9	−65	41.7	10.5	−75
Maximum horizontal force** on locomotive due to unbalanced reciprocating weight on both sides of locomotive in 1,000 lb. for:												
60 m.p.h.	22.0	16.6	−25	45.3	21.8	−52	41.8	31.0	−26	33.3	26.2	−21
80 m.p.h.	39.1	29.5	−25	80.7	38.7	−52	74.4	55.1	−26	59.2	46.5	−21
100 m.p.h.	61.0	46.1	−25	126.0	60.5	−52	116.2	86.1	−26	92.5	72.7	−21
120 m.p.h.	87.9	66.4	−25	181.4	87.2	−52	167.4	123.9	−26	133.2	104.8	−21

* Main-line passenger service mileage to January 1, 1937—182,000 miles.
† Main-line passenger service mileage to January 1, 1937— 81,000 miles.
‡ There are 50 new locomotives now being built; five are equipped as shown, while the other 45 have Timken reciprocating parts only.
§ Locomotives being rebuilt.
¶ Revolving weight is completely counterbalanced on all of the locomotives shown in this table. Cross-balance is used on all except the Pennsylvania K-4-s locomotive, where a static balance is used on both the Timken and plain-bearing designs.
‖ Not available.
** NOTE: The New York Central is building 50 new 4-6-4 locomotives, designated as Class J-1-F, with 22½-in. by 28-in. cylinders, 79-in. drivers, and 300 or 275 lb. boiler pressure; 45 of these locomotives have Timken reciprocating parts only, and 5 have Timken revolving and reciprocating parts. On the latter 5 locomotives the same revolving and reciprocating weights, dynamic augments and maximum horizontal forces apply as given for the Timken parts on the N. Y. C. 4-6-4 Class J-1-E locomotive in the table.

static and dynamic rail loads permissible on the track structure, the present motive power, with high static axle loading, does not permit doubling the dynamic augment. At diameter speed, the combined rail load is already about the permissible value.

In addition to the objectionable large dynamic augment developed at high speeds, other difficulties arise which are evidenced by increased nosing, swaying, and fore-and-aft oscillations of the locomotive. Vibrations of these types prevent smooth operation and lead to increased maintenance costs for both the track structure and the locomotive itself. The forces causing these vibrations are proportional to the square of the speed.

Driving wheels on freight engines are frequently too small to balance the rotating parts fully, so that the reciprocating weights remain entirely unbalanced. A large underbalance will result in excessive dynamic augment since every pound of unbalanced rotating parts represents a rail blow of about 50 lb. at diameter speed. In addition to this deleterious effect of large dynamic augment, this unbalance gives rise to horizontal forces which must be transmitted through the locomotive members and track structure. The maximum horizontal force on the locomotive frame, axle, and other parts is

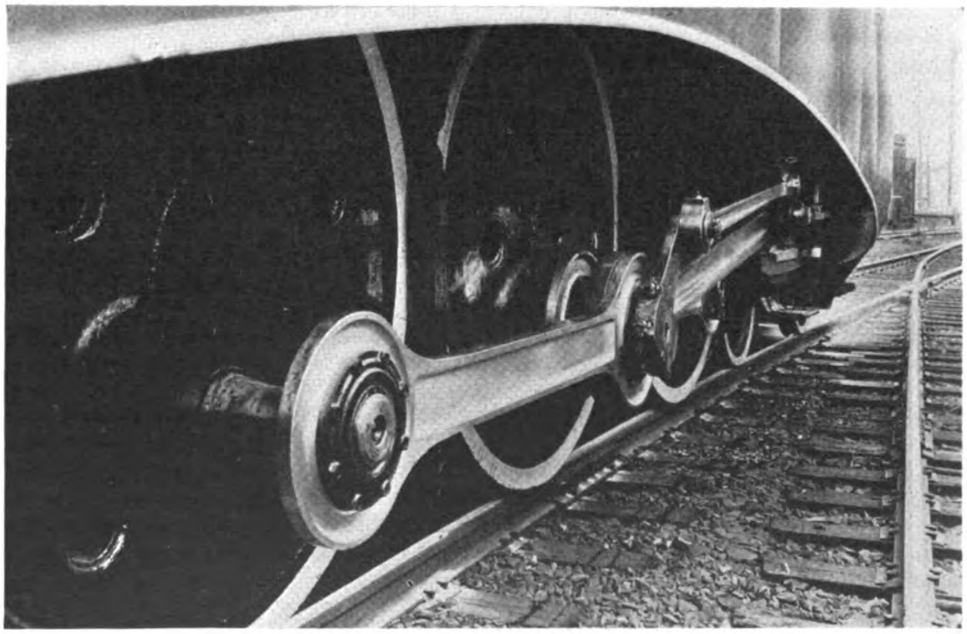


Fig. 1—The Timken rod application on a New York Central high-speed streamlined passenger locomotive

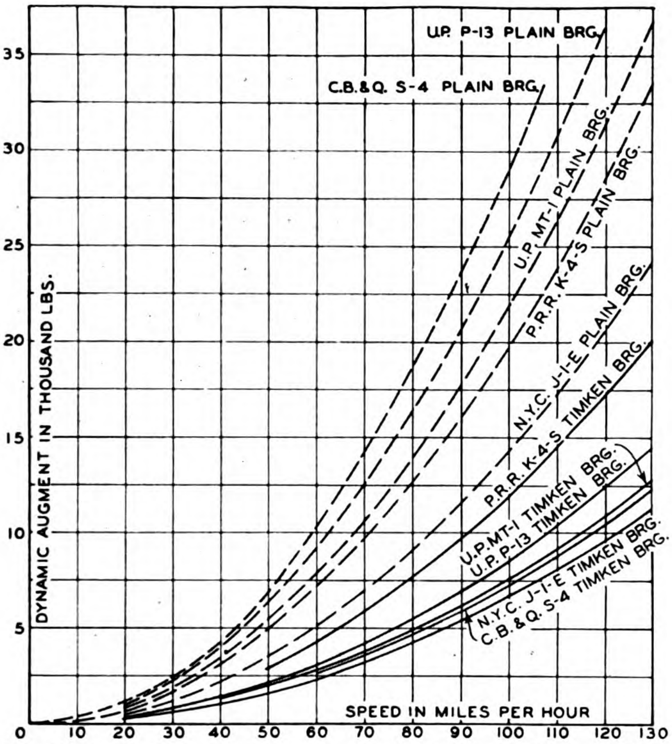


Fig. 2—Reduced dynamic augment obtained by using Timken roller-bearing rotating and reciprocating parts rather than plain-bearing parts

that due to the unbalanced rotating parts just mentioned plus that from the unbalanced reciprocating parts. This maximum force is about 70 lb. for every pound of reciprocating and unbalanced rotating parts. If this force were allowed to become excessive at high speeds, additional strength in locomotive members would be required. Furthermore, these unbalanced weights result in forces producing nosing and fore-and-aft vibrations of the locomotive, although the long and heavy wheel base may tend to reduce the nosing.

The driving wheels on passenger locomotives are large enough to be properly balanced for all rotating weights and an ample percentage of the reciprocating parts. If a small percentage of the reciprocating parts are balanced, to favor a low dynamic augment, then the horizontal forces on the locomotive frame and running gear as well as vibrations from nosing and fore-and-aft movements would be excessive, although the use of the two-axle trailer trucks may improve the nosing condition. Thus, we come to the conclusion that counterbalancing offers no complete solution to the problem since it is merely a compromise between balancing for the vertical and horizontal forces.

This means that higher speeds will require either a reduction in the weight of the reciprocating and rotating parts, or improved and strengthened locomotive and track structure. Obviously, the former is the logical and economical procedure to follow, and such was the basis for the development of the Timken lightweight design. Weight reductions in reciprocating parts of 1,072 lb. per side and up to 52 per cent of the conventional designs have been made as shown in Table I. The very favorable dynamic augment curves for the lightweight application in comparison with those for the heavy design it replaced are given in Fig. 2 for the axles of main driving wheels of locomotives given in Table I. The curves show in general that it is possible by the reduction in weight to increase the diameter speed of steam locomotives by about 35 m.p.h. without change in dynamic augment.

Table II—Comparison of Weights of Plain-Bearing and Timken Rods

	Side rods		Main rod	
	Plain bearing	Timken	Plain bearing	Timken
Weight on main pin, lb.......	556	338	581	319
Weight on front pin, lb.......	190	150	...	...
Weight on rear pin, lb.......	176	150	...	...
Weight on crosshead pin, lb...	...	...	422	210
Total, lb.	922	638	1,003	529

Design of Lightweight Reciprocating Parts

The general arrangement of the application of lightweight revolving and reciprocating parts is shown in Fig. 1. The shapes of all the parts deviate considerably from conventional design and are determined by the proper distribution of metal to give maximum strength with minimum weight so far as this is consistent with good forging and machining practice.[1]

The eye ends of the rods are deep and narrow I-sections which efficiently give considerable rigidity and low bending stresses. This feature is to be contrasted with the usual wide and heavy rectangular section required to obtain the customary low plain-bearing pressures, which contribute to large bending stresses in the column section due to eccentric loading possible over the wide ends, as illustrated by Fig. 3. A comparison of the weights of plain-bearing and Timken rod is given in Table II. The column stresses due to eccentric loading are reduced to a very low value because the narrow width of the rod ends and their simple knuckling action on the outer race of the bearing permit very little eccentricity. This knuckling action takes place on a 3/16-in.-thick rolled-strip phosphor-bronze bushing pressed into the rod eye and crowned on the surface floating over the outer bearing race. The column portion of the rods is an I-section, and, to carry the column and centrifugal stresses economically it is tapered from a center straight portion to a width of about six-tenths as great at the ends. The usual knuckle-pin joints in side rods and the usual oil and grease holes through the rod eye, which introduce high local stresses and are the cause of many rod failures, have been eliminated. The rear side rod is located in a plane outside the main rod as

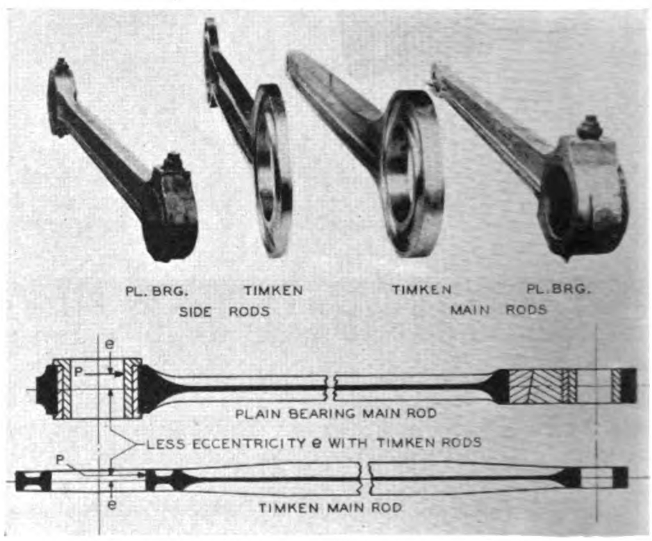


Fig. 3—Comparison of Timken lightweight rod design and decreased eccentricity of loading with plain-bearing rods for a 4-6-4 high-speed passenger locomotive

[1] A complete description of Timken roller-bearing rods was published in the *Railway Mechanical Engineer*, December, 1935, pp. 490-494.

a means of reducing the bending stresses and bearing load on the main crankpin.

The crankpins are made of thin-walled and tapered tubular sections. The crankpin bearings are of the usual Timken tapered design and are fitted directly to the crankpins. The crosshead pin also functions as the inner race of the bearing. The piston rod is a thin-walled tube. The usual massive one-piece cast-steel crosshead is entirely redesigned, eliminating the taper-key connection and using a two-piece construction of thick plates die forged to proper shape.[2] The conical piston is a forged and rolled shape of comparatively thin sections and its extremely low weight permits very successful operation with only two piston rings. The thin plate section of the piston permits deflections several times as great as the usual piston, and this is of value in reducing stresses when water is carried over from the boiler or from condensation in the cylinder. Comparison photographs of reciprocating assemblies for the conventional and Timken lightweight designs are shown

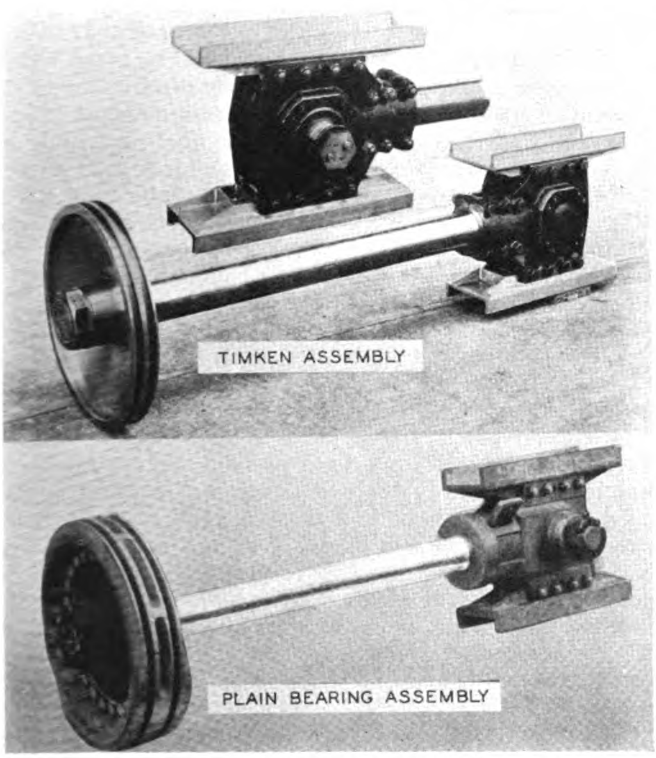


Fig. 4—Comparison of Timken design with conventional design of reciprocating parts for a 4-6-4 high-speed passenger locomotive

in Fig. 4. Table III gives the comparative weights of the two assemblies shown in Fig. 4.

Before such service applications could be made on the driving and running gear it was necessary to give considerable study to (*a*) the selection of the proper materials and heat-treatment, (*b*) methods of manufacture, and (*c*) testing to facilitate stress analysis of the various members.

The material selected for the rods, pistons, and principal members constituting the revolving and reciprocating parts is Timken high-dynamic steel of a Cr-Ni-Mo type, having the following nominal chemical analysis: 0.37 per cent C; 0.70 per cent Mn; 0.27 per cent Si; 0.75 per cent Cr; 1.60 per cent Ni; 0.25 per cent Mo. The approximate heat-treatment of all steel parts is a quench in caustic-soda solution or oil at 1,440 deg. F., after which a tempering treatment at 1,200 deg. F. is given. The average physical properties of this steel are shown in Table IV, and for comparison purposes similar properties are given for an aluminum alloy and for plain-carbon-steel forgings in accordance with A.A.R. specifications.

The driving rods, piston, and crosshead are all die forged; the piston rod is made from cold-drawn steel tubing, and the crankpins are hammer forgings. In order to obtain the beneficial effects of grain flow, the development of die shape and forging technique was required. The uniform and maximum strength characteristics obtained by favorable grain flow is indicated by the fact that the maximum and minimum test results of specimens taken from 13 points around the eye of a side rod were: Yield point, 119,500 lb. and 127,500 lb. per sq. in., respectively; ultimate strength, 136,500 lb. and 142,000 lb. per sq. in., respectively; elongation, 19.5 and 22.5 per cent, respectively, and reduction of area, 52.8 and 61 per cent, respectively.

Table III—Comparison of Weights of Timken and Plain-Bearing Reciprocating Parts

Part	Weight of plain-bearing parts, lb.	Weight of Timken steel parts, lb.
Crosshead assembly	754	367
Piston, piston rod, and parts	765	350
Front end of main rod	422	210
Union link and bushing	30	17
Total	1,971	944
Per cent	100	48

Table IV—Average Physical Properties and Strength-Weight Factors of High-Dynamic and Other Steels

Properties	Timken high-dynamic Cr-Ni-Mo	Plain carbon, A.A.R. spec.	Aluminum alloy, 25 ST
Yield point, lb. per sq. in.	115,000	55,000	35,100
Strength-weight ratio	14.70	7.00	12.70
Tensile strength, lb. per sq. in.	132,000	90,000	55,100
Strength-weight ratio	16.80	11.50	19.90
Endurance limit, lb. per sq. in.	62,000	39,000	12,600
Strength-weight ratio	7.90	5.00	4.60
Elongation in 2 in., per cent	22.00	28.00	13.70
Reduction in area, per cent	65.00	50.00	.....
Brinell hardness	285.00	160.00	110.00
Specific gravity	7.85	7.85	2.77

Axle Design

The fatigue strength of axle assemblies, particularly the weakening effect due to the press fit of the wheel on the axle, and the impact forces on axles at high speeds are being studied in full size assemblies by testing them in the locomotive axle testing machine recently installed in the Timken Research Laboratories.

These studies are being made on a testing machine capable of determining the fatigue strength of full-size locomotive axle assemblies 8 ft. long and up to 14 in. in diameter. Axle fatigue failure develops within the wheel fit just inside the inner wheel-hub face. The general nature and the location of the axle failure produced on this machine is comparable to that produced under actual service conditions. However, at the time this paper was written, sufficient data had not been obtained to justify even preliminary conclusions regarding the fatigue strength of full-size axles. A complete description of this axle-testing equipment was published in May, 1937, issue of the *Railway Mechanical Engineer*.

[This concludes Part I of this paper; the second part, devoted to a complete discussion of the factors involved in the design of Timken lightweight reciprocating and revolving parts, will be published in a subsequent issue.—Editor.]

[2] The light-weight Timken crosshead assembly was described in the June 18, 1937, *Railway Age Daily Edition*, page 1004-D101

Determining the

Strength of Riveted Patches*

By J. P. Morrison†

Discussion of the material, workmanship and the design of riveted patches — Some example calculations of typical riveted-patch problems included

RIVETED patches have for many years been recognized as an economical and practical repair of boiler shells and boiler drums containing localized defects. When trouble has been experienced with patches after they have been installed, it has been traceable to the conditions responsible for the original defect; to details of the repair procedure in the preparation of the plates forming the patch seam, such as poor fitting, improper drilling and insufficient scarfing; or to defects in the metal of the shell or patch.

The following discussion of riveted patches deals with material, workmanship, and design, in that order.

Material

Patch material should be fire-box or flange steel, never steel of unknown or inferior quality, and should be of the same thickness as the plate to be repaired. If the original plate is dangerously reduced in thickness because of corrosion, patching should not be attempted, even to continue the boiler in service until new equipment can be obtained, without the approval of persons fully experienced in judging the dependability of such temporary repairs. Boiler shops must be prepared to produce a copy of the steel maker's test reports for all material used in boiler repair work. If it becomes necessary to divide a plate so that a part of it will not bear a "steel maker's brand," an authorized boiler inspector or steel manufacturer's representative should be called to witness the transfer of the brand before the plate is cut.

Rivets, patch bolts, and staybolts must be made of material of good quality.

Workmanship

In each case the distorted sheet should be straightened to the greatest extent its condition will permit, so that the section removed and the patch will be no larger than necessary. A patch should be placed on the inside of the sheet when it is possible to do so, except that if a blow-off connection is included, the patch should be placed on the outside of the sheet. If the part of the shell that needs strengthening is not exposed to the products of combustion nor affected by deposits from the boiler feedwater, it is not necessary, when applying a patch, to remove the defective plate, unless it is greatly distorted.

All rivet holes should be drilled full size or the holes may be punched not to exceed 1/4 in. less than full size for plates over 5/16 in., and 1/8 in. less for plates 5/16 in. or less in thickness, and then reamed to full size with the patch in place. Rivet holes are usually 1/16 in. greater in diameter than the normal diameter of the rivet, but a 1/32 in. difference is preferable when rivets are of uniform size. The foregoing specifications for riveted work are those in the A.S.M.E. Boiler Code, covering new construction.

Rivet holes for patch seams may be countersunk, if desired, but the angle of the chamfer with the longitudinal axis of the hole should not exceed 45 deg. and the depth should be no greater than half the thickness of the plate. The excess strength of the ligaments between the rivet holes over the strength of the rivets, is such that no deduction in the calculated efficiency need be made on account of material removed in countersinking the holes.

Rivets, patch bolts, or staybolts may be used in "riveted" seams in stayed or braced surfaces such as are found in locomotive type and vertical tubular boilers. If staybolts are used in lieu of rivets in a seam, there should be a rivet or a patch bolt between each staybolt and the next adjacent staybolt, and the staybolts should be installed after the riveting or patch-bolting has been completed.

When possible, the edges of a patch should be chipped or planed to the proper bevel for caulking before the patch is fastened to the boiler.

A riveted patch should be tight under a hydrostatic test equivalent to the working pressure before any seal welding is done. In the event that seal welding is applied, the metal should be deposited in a single bead having a throat not less than 3/16 in. nor more than 5/16 in., since contraction stresses resulting from the use of numerous and heavy beads of seal welding contribute to failures. The plate should be at a temperature of at least 60 deg. F when any welding is done. A properly applied patch, however, should not have to be seal welded to secure tightness.

When three or more plates over-lap at a seam, it is necessary to scarf the center plate to a feather edge (a reduction in thickness to 1/32 in. or less) the entire width of the lap. The thickness of the scarfed plate may be reduced to one-half of its normal thickness at the lap rivet hole next to the scarfed edge.

The width of the lap of two plates forming a single-riveted patch seam has been the subject of disagreement. Some designers hold to the rule of three times the diameter of the rivet hole, which applies to longitudinal seams, while others favor a narrower lap, such, for instance, as one meeting the requirements for a girth seam, which is 2.5 times the diameter of the rivet hole. Those ideas are based upon the crushing load, tending to disturb the section of the plate between each rivet hole and the caulking edge or the edge of the inside lap, and take into consideration stresses due to poor operating conditions such as over-heating, rather than the stresses due to pressure alone.

The resistance to heat transfer through two plates forming an excessively wide lap is greater than through plates forming a narrower lap. Accordingly, there is an advantage in using a comparatively narrow lap, that is, one approximately 2.5 times the diameter of the rivet

* From an article published in the July issue of The Locomotive, a publication of The Hartford Steam Boiler Inspection and Insurance Co.

† Assistant chief engineer, boiler division, Hartford Steam Boiler Inspection and Insurance Co.

hole to avoid over-heating the edge of the plate and consequent fire cracks. The over-heating in any case is reduced to a minimum by keeping the inside surfaces clean, but, as a general statement, the original difficulty develops as the result of scale or oil or both, so that the patch is likely to be subjected to the same over-heating as the shell plate.

Seams of patches not exposed to the products of combustion may be similar to the corresponding seams of the boiler, and in most cases should be at least double-riveted.

Design

In "The Locomotive" for July, 1897, and again for July, 1908, there were articles on the design and strength of diagonal joints. The thoughts then expressed were directed toward the use of helical seams in boiler construction, rather than to the design of diagonal seams of patches, but the subjects are so closely allied that in a general way stresses developing in one kind of seam are found in the other.

In patch terminology the "length" of the patch is the dimension parallel to the longitudinal seam and the "width" is that parallel to the girth seam, regardless of which dimension may be the longer.

Experience with patches indicates that, if the maximum length of the patch between rivet center lines (the dimension L as shown in Figures 1, 2 and 3) does not exceed 24 in., it is not necessary to give specific consideration to the strength of the diagonal patch seam, if the proper materials are used, the workmanship is good, and the diameter and spacing of the rivets is normal for the thickness of plate.

When a patch is being designed, it should be kept in mind that the best results are obtainable with crescent, oval, triangular or diamond shaped patches *with a width at least twice the length* and all "corners" well rounded.

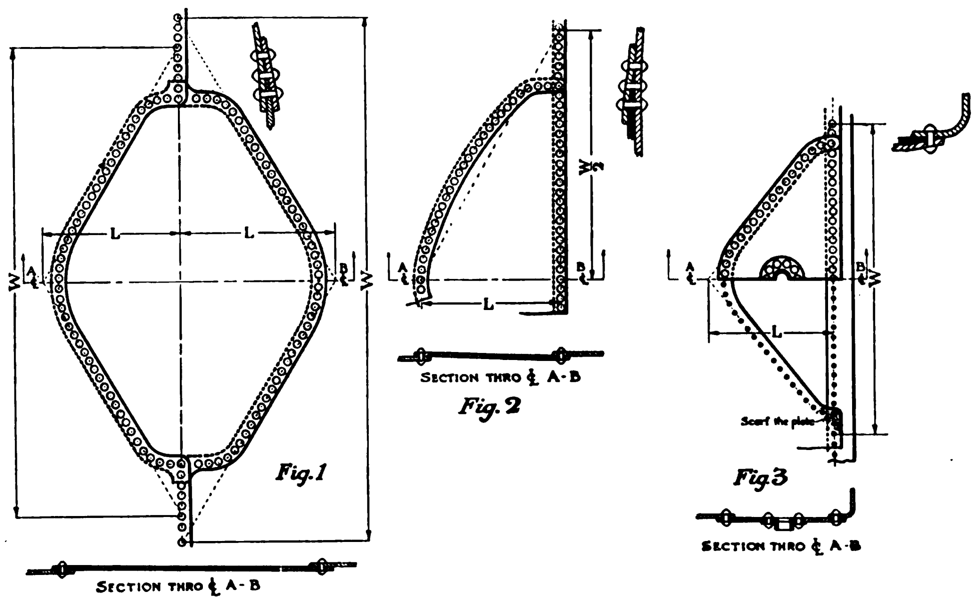
Writers have applied various terms to the relation between the efficiencies of circumferential, diagonal and longitudinal seams when comparing one with the other. In the interest of simplicity, reference herein will be made to circumferential efficiency, diagonal efficiency or longitudinal efficiency, when referring to the efficiency of a seam.

In determining the required efficiency of a diagonal seam, it is necessary to know the angle that this seam is to make with a seam of known efficiency. Some writers refer to the angle formed with the girth seam, while others refer to the angle made with the longitudinal seam or with a line parallel thereto. The diagonal efficiency should be based upon the latter angle, because the longitudinal efficiency is of most importance in the calculations made to determine the maximum safe working pressure of the boiler.

The present boiler rules in some jurisdictions use the diameter of the boiler in determining the angularity of a diagonal seam. However, since the angle of a seam depends upon the angle given it when the sheet is laid out "in the flat" and since that angle remains constant regardless of the diameter of the boiler upon which the patch is placed, the diameter of the boiler is not a contributing factor.

In order to simplify the designing of patches and to avoid the necessity for dealing with angles and the trigonometric functions of angles, tables of efficiencies and factors (Tables I and II) have been prepared.

Sketch of patches as viewed from outside the boiler or vessel



The necessity of designing a patch occurs after weakening or distortion of the boiler shell. The size and shape of the patch are, therefore, predetermined to a large extent by the area of the defect. In addition, the length and width, as herein defined, determine the direction of the patch seam. Accordingly for the practical designing of patches, the plan recommended is based on the relation of the longitudinal dimension L and the circumferential dimension W in the following formula:

$$L/W = K^{\ddagger}$$

thereby eliminating the necessity for measurement or calculation of angles.

The factors upon which the diagonal efficiencies of the seams are based are shown in Table II, Column K, for as many combinations of L and W as are necessary for any desired shape or size of patch. The closest factor should be used if the formula $L/W = K$ gives a factor between two of those given in the table, or, the factor may be determined by interpolation. (See problem 3.)

If a patch is oval or diamond-shaped, it may be con-

‡ In the interpretation considered and approved by The National Board of Boiler and Pressure Vessel Inspectors, the formula $W/L = C$ and the angle made by the diagonal seam with the girth seam are used. This method requires different factors for Table II, but the results in solving any problems are the same.

sidered as two patches, using half the longitudinal dimension as L in determining the constant K. Also, if a patch of that description projects in both directions from the girth seam, as illustrated in Fig. 1, L should be measured in each direction from the line of rivet centers of that seam.

Table II, Column F-1 (for vessels in which approximately 75 per cent of the end load is carried by head-to-head braces, tubes or an internal furnace) and F-2 (for vessels in which the heads and shells carry the entire load), give factors representing the relation of the efficiency of the longitudinal seam of a boiler which is to be repaired and the efficiency of the patch seam appearing in column e of Table I. That relation or factor of relative efficiency is found by dividing the boiler-seam efficiency by the patch-seam efficiency thus:

$$F\text{-}1 \text{ or } F\text{-}2 = \frac{\text{longitudinal efficiency of the boiler seam}}{\text{longitudinal efficiency of a seam similar to the patch seam}}$$

The longitudinal efficiency of the boiler seam is calculated in accordance with the A.S.M.E. Boiler Code rules, while the normal or longitudinal efficiency of the patch seam is readily obtained by the use of Table I, using the same plate thickness, diameter of rivet hole and pitch of the rivets for the patch as for a similar seam for the vessel itself. Efficiencies in Table I are for single-riveted seams.

The factors of relative efficiency in Column F-1 are based upon the following formula for F-1, developed to include consideration of those longitudinal forces over and above the load carried by the tubes, through-rods, and similar head-to-head supports. Of course, no credit can be given for diagonal braces, unless such braces extended from the head to the shell in such a way as to support the surface to be patched.

$$F\text{-}1 = \frac{1}{\sqrt{\cos^2 a + .015625 \sin^2 a}}$$

The factors of relative efficiency in Column F-2 were calculated from the following formula which applies to diagonal seams of patches to cylinders with unbraced heads, such as a drum of a water-tube boiler.

$$F\text{-}2 = \frac{2}{\sqrt{1 + 3\cos^2 a}}$$

The formulas for determining F-1 and F-2 are given here merely as a matter of information. The use of the tables of factors simplifies the calculations.

The values for the efficiency of the seam given in the fourth column of Table I represent the strength of the rivets in some cases and the strength of the net section of the plate in others, depending upon which is weaker. There may be cases in which the range of combinations of plate thickness, rivet diameter, and rivet pitch, is such that the choice of one rivet diameter results in a weak net section and a high rivet shear, while the choice of a smaller rivet has the opposite result. In such cases it is best to select the larger rivet, because the shearing stress in the rivet of a diagonal seam is relatively greater than the tension stress in the diagonal ligament between the rivet holes.

Given certain of the items necessary for the specifications of a patch, it is possible from Tables I and II to derive the other information necessary, whether for the purpose of designing a satisfactory patch or for checking the strength of a patch already in place. The problems at the end of the article illustrate the procedure to be followed.

The relation between the longitudinal efficiency and the diagonal efficiency of a seam, or the factor representing that relation, depends upon the relation between the girthwise stress seeking to tear the object apart along a horizontal line, and the longitudinal stress seeking to separate the plate or seam in a girthwise direction.

A water-tube boiler having unbraced heads has a girthwise stress twice the longitudinal stress, and accordingly a standard-design girth seam may be said to be twice as efficient as a *similar* longitudinal seam.

A diagonal seam making an angle of 45 deg. with the longitudinal seam and the same angle with the girth seam would have an efficiency 26 per cent greater than the efficiency of a longitudinal seam of the same design, as shown in Table II, F-2 for the factor .500 which is that for the 45-degree angle, made by a patch having a width equal to twice the length.

However, if the tubes and through-rods of a horizontal tubular boiler, for example, are carrying 75 per cent of the longitudinal or end stresses, a diagonal seam forming a 45-deg. angle would have a diagonal efficiency 40 per cent greater than the efficiency of a *similar* longitudinal seam, because the diagonal seam carries no more

Table I — Riveted Patches — Seam Efficiency
Single-Riveted Seams

Plate thickness t	Rivet hole diameter d	Pitch of rivets p	Longitudinal efficiency of patch seam e
1/4	11/16	1 7/8	63.3
9/32	3/4	1 7/8	60.
5/16	3/4	1 7/8	60.
11/32	13/16	1 15/16	58.
3/8	13/16	1 15/16	57.
13/32	7/8	2 1/16	57.5
7/16	15/16	2 1/4	56.
15/32	15/16	2 1/8	55.5
1/2	1	2 1/4	52.5
9/16	1 1/16	2 3/8	53.
19/32	1 1/16	2 1/4	52.8
5/8	1 1/16	2 1/4	50.5
21/32	1 1/16	2 5/16	51.4
11/16	1 1/8	2 5/16	51.4

TS 55,000 lb. SS 44,000 lb.

than 25 per cent of the end load. (See Table II, F-1 opposite .500 for K.)

If the length of a patch is to exceed 60 in., consideration should be given to the use of a sheet having a width equivalent to five-eighths of the circumference of the boiler and with longitudinal seams of a design similar to that of the original boiler seams.

When rebuilding the furnace walls after a repair of this kind, dependable means should be provided to protect the new longitudinal seams from the products of combustion.

In designing any patch, three or four rivets on a longitudinal line should not be considered as affecting the diagonal efficiency of the patch seam, because it is almost impossible to secure tightness by caulking a sharp corner, and it often is necessary to have from one to four rivets on a line at right angles to the girth seam in order to round out the circumference of the patch. Figs. 1 to 3 show the characteristic rounded corners necessary for good patch design.

If a patch having diagonal seams is riveted to the shell of a boiler in which the head-to-head braces or tubes or both carry 75 per cent of the end load, and the diagonal seam forms an angle of 60 deg. or more with the longitudinal seam of the boiler (in which case L/W would be less than .288), the strength of the seam may be disregarded, provided the workmanship is satisfactory and the design is normal for the vessel to be patched.

If the diagonal seam forms an angle of 30 deg. or less with the longitudinal seam of the boiler (in which case L/W would be .866 or over), the factor expressing the relation of the strength of that diagonal seam to a longitudinal seam of similar design is so small that the

diagonal efficiency may be disregarded and the strength of the boiler as a whole based upon the efficiency of such a seam considered as a longitudinal joint. When such a repair is contemplated and a material reduction in pressure is not desired, it is recommended that one of three things be done: (1) That a patch be installed having an L/W factor K not more than .500 (for a 45-deg. angle, (2) that a five-eighths ring or a complete ring be substituted, or that (3) a new boiler be installed.

The three figures illustrate how patches of proper design may be correctly installed.

Fig. 1 represents a method of applying a patch to include a part of each sheet adjacent to a girth beam. It will be assumed that there has been serious deterioration as the result of over-heating, bulging, fire cracking and corrosion, so that repairs are needed to both sheets. The use of a single patch, somewhat oval in shape, simplifies the repair, but the scarfing of the patch plate where it is inserted in the old sections of the girth seam requires extreme care. The patch sheet forms the inside lap of the front seam and forms the outside lap of the rear seam. It will be noted that the calculation of the strength of the diagonal or oval seam is based upon L/W considering L as the length of the patch in each direction measured from the center line of rivets of the girth seam. This same sort of a patch may be easily adapted to a location away from any riveted seam by following the principles heretofore outlined.

Table II — Patch Seams
Table of Factors

$L/W = K$	F-1	F-2
.866	1.15	1.11
.832	1.16	1.11
.800	1.17	1.12
.769	1.18	1.13
.741	1.20	1.14
.714	1.21	1.15
.688	1.23	1.16
.663	1.25	1.17
.640	1.26	1.18
.617	1.28	1.19
.596	1.30	1.20
.575	1.32	1.21
.555	1.34	1.22
.536	1.36	1.24
.518	1.38	1.25
.500	1.40	1.26
.482	1.42	1.27
.466	1.45	1.29
.450	1.48	1.31
.434	1.51	1.32
.419	1.54	1.34
.404	1.57	1.35
.390	1.60	1.36
.376	1.64	1.38
.363	1.68	1.40
.350	1.72	1.42
.337	1.76	1.43
.325	1.80	1.45
.312	1.85	1.47
.300	1.90	1.49
.288	1.96	1.51

L = Longitudinal dimension of patch between rivet centers.
W = Circumferential dimension of patch between rivet centers.
F-1 = Factor where 75 per cent of the end load is carried by through braces or tubes.
F-2 = Factor where heads and shells carry entire load.
$K = L/W$; $L = WK$; $W = L/K$.

Fig. 2 shows a crescent-shape patch with the girth seam used as one of the patch seams.

Fig. 3 illustrates a method of patching the rear course of a horizontal tubular boiler where the patch is to include the blowoff connection. It will be noted in this case that it is necessary to scarf the boiler shell plate where the patch, shell plate and head lap at each end of the patch.

Examples of Calculations of Riveted Patches

Problem 1. Design of Patch—A triangular patch is to be placed on the fire sheet of a horizontal return tubular boiler having shell plate 7/16 in. thick, and longitudinal seam efficiency 74 per cent. The length of the patch is to be 36 in. and a reduction of pressure is to be avoided.

Find the width W of a patch to be applied, using a single-riveted seam of normal design.

Referring to Table I, we find that a 7/16 in. plate with 15/16 in. diameter rivet holes and pitch of a 2¼ in. gives a seam efficiency of 56 per cent.

The factor of diagonal efficiency is found by dividing the longitudinal efficiency of the boiler seam by the longitudinal efficiency of a seam similar to the patch seam or $.74/.56=1.32$.

From Table 2 in Column F-1, we find a factor of 1.32 requires an L/W constant of .575.

As $L/K=W$, 36 in./.575=62.5 in.

Accordingly, as the length of the patch is 36 in., its girthwise dimension or width must not be less than 62.5 in., if the boiler is to be permitted to carry its present pressure.

Problem 2. Pressure Allowance on an Existing Patch—A horizontal tubular boiler has a patch 30 in. long by 48 in. wide. The patch is of crescent shape and has single-riveted seams.

The boiler shell plate is ⅜ in. thick, the longitudinal seam is of the double-riveted butt strap type having an efficiency 82 per cent, and the safety valve pressure is 125 lb., but can be reduced to 110 lb. without interfering with the operation of the plant.

What maximum working pressure may be allowed on the boiler, if the single-riveted patch seam has 13/16 in. diameter holes pitched 1 15/16 in. apart, giving a longitudinal efficiency of 57 per cent?

The constant, from which a factor of diagonal efficiency for the single-riveted seam is found, is determined by dividing the length of the patch by the width ($L/W=K$) or 30/48 equals .625.

There is no constant .625 in Column K so the closest constant is selected which is .617 and the corresponding factor in Column F-1 is 1.28.

Since the patch seam would have longitudinal efficiency of 57 per cent and a diagonal factor of 1.28, its diagonal efficiency is $.57 \times 1.28$ which equals .73 or 73 per cent.

The pressure permitted on a boiler varies directly as the seam efficiency. Accordingly, $(.73/.82) \times 125$ equals 111 lb. pressure.

The boiler may be continued in service with the safety valve adjusted to 110 or 111 lb.

Problem 3. Design of a Patch for a Water Tube Boiler Drum—A patch is required for the shell of a longitudinal-drum water-tube boiler. Sections of the plate having a total length of 36 in. (making L 18 in.) are to be removed on each side of a girth seam. The patch will be oval in shape. A reduction in pressure would necessitate replacing the boiler.

The shell plate is 7/16 in. in thickness with a double-riveted butt-strap longitudinal seam having an efficiency of 82 per cent.

What will be the width of an oval patch?

From Table I we find a single-riveted lap seam in 7/16 in. plate, 15/16 in. diameter rivet holes, 2¼ in. pitch, has an efficiency of 56 per cent.

The factor of diagonal efficiency is found by dividing the longitudinal efficiency of the boiler seam by the longitudinal efficiency of the single-riveted patch seam; therefore, .82/.56 equals 1.46.

Table 2, Column F-2, has no factor 1.46, but there is a factor 1.45 which corresponds to the constant .325 and there is a factor 1.47 which corresponds to constant .312, so by interpolation, a constant for factor 1.46 would be .318.

As the patch is to be oval, the width of the patch would be $W=L/K$ or 18/.318=56.6 in.

EDITORIALS

Readers as Editors

This particular part of the *Railway Mechanical Engineer* is restricted to comment by editors. But what do our readers think about current problems and tendencies? What difficulties are giving them special concern, and what are they doing to overcome these difficulties?

Without special thought or preparation on our part, the Gleanings page, consisting of high-spot paragraphs from letters in the editor's mail, was started a couple of years ago. These paragraphs, unsigned in order to protect the writers from any possible embarrassment, have met with cordial response by our readers, probably because they express in their own way the thoughts and feelings of their associates performing the actual work out in the field. The Gleanings page long ago passed from its experimental stage and has become one of our features. May we express public appreciation, therefore, to those who unconsciously, in most cases, have assisted in making such a valuable contribution to our columns.

A Turning Point—An Opportunity

Once again, after an interval of several years, the supervisors of the mechanical departments of American railroads will gather in late September for the conventions and joint exhibit of five mechanical associations. To the many hundreds of railroad men who, because of the adverse economic conditions since 1930, have been denied the inspiration of personal contact with fellow-supervisors from other parts of the country these meetings will mark an occasion of outstanding value to them in their work. No one can deny the actual dollars and cents value of an opportunity to "swap" ideas and bring back to his own shop an idea for the solution of a problem that may have troubled a man for many months. So much for the value of association meetings. There is another matter of importance to be considered at this time.

Supervisors who have been connected with these associations in the past have heard a great deal of comment during the depression about proposals for consolidating or even abandoning some of these groups. In all fairness to railroad managements and the officers responsible for policies and expenditures it must be admitted at the outset that as one looks back over the work and conduct of many railroad conventions between 1919 and 1930 it might not be too difficult to discover logical reasons why some railroad officers were beginning to question the worth of these meetings. It is no secret that many mechanical officers were and still are not in favor of sending their men to such meetings and in very few cases is it a matter so much of personal prejudice as of business judgment. Only recently an officer known and respected for his broad vision and the efficiency of his organization remarked that unless certain of the mechanical associations soon recognized the necessity of developing meeting programs of more interest and real technical value their continued existence is a matter of question. These are not particularly pleasing facts but they are none the less important.

As the reports on the preparation of programs for the meetings of the five associations to be held in late September come in it is apparent that the several association officers realize the urgent necessity of presenting material of unquestionable quality in order to build up these organizations again to the positions of prestige and influence they once held. These 1937 meetings may prove to be a turning point in the affairs of some of these associations.

Through the past seven years their activities have been at a low ebb during a time when some of the most radical developments in railroad history have come into being. This very situation offers an exceptional opportunity this year to plan a group of meetings of such absorbing interest and value to the railroads that they will leave no doubt in the minds of the higher officers of the service that can be rendered in the future by encouraging this type of association work.

Sometimes it looks as though many of our railroad supervisors are too close to their everyday jobs to be conscious of the opportunities that lay in their path. Too seldom do they realize that, after all, they constitute, collectively, one of the most important links in the chain of railroad organization. They are the men on whom management must rely to carry out the myriad of details involved in successful and profitable operation. It is for the purpose of providing a melting pot in which the individual ideas of these men may be refined and from which they may be disseminated for the benefit of others that the so-called "minor" associations came into being. All of that vast field of endeavor which may be classified as operation and practice in railroading is the legitimate ground in which these minor associations may work.

It is not the function of these associations to decide policies, effect working agreements between railroads, or set standards for material and design of equipment but rather to plan their activities in such a way as to

bring to light out of the experience of their members the practicability of the methods that must be employed to maintain equipment designed by others under standards and regulations established by others. The success or failure of equipment maintenance depends, to a large extent, upon intelligent supervision.

Any discussion of this subject should not be concluded without mentioning the value of association work to the members as individuals. It provides a medium through which they are bound to broaden their outlook. Through the competition of ideas between equals they learn the value of tolerance, so necessary in the development of true leadership and co-operation with others. The opportunities in association work for the development of self confidence in the exercise of leadership are almost numberless. All through the years among the most prominent railroad officers are those who have labored in the interests of their respective associations. Who are the supervisors of today but the officers of tomorrow?

The value to the railroad of these organizations in the development of men alone is too great to permit them to be permanently discontinued and the responsibility on the part of those guiding their affairs at the present time to see that the programs for this year's meetings command the interest of every supervisor and the respect of every officer is great. If this opportunity is grasped, the place of these associations in the railroad field should be established for years to come.

Railway-Shop Applications Of Cemented-Carbide Tools

The use of cemented-carbide tools in railroad shops, particularly locomotive shops, is rapidly increasing with the realization that these tools can effect production savings on machines employed for a variety of work involving the same as well as different kinds of metals. Although these tools show their best qualities on machines which can be run at high speeds, they can also show distinct savings where the only advantage is the greatly increased length of tool life between grinds. This latter fact is especially true where the tools can be applied to machines the mechanical condition of which is such that extremely high speeds cannot be maintained due to resultant vibration which is detrimental to higher-priced cemented-carbide tools. However, certain speed increases can be made even though such speeds are much lower than those the tools are capable of handling. This again is an advantage inasmuch as the life of the tool is extended beyond that which could be obtained if the machine were run at its maximum speed, thereby increasing further the production per tool between grinds while at the same time it will show a saving from whatever speed increases are possible within the ability of the machine to do the work without vibration.

Every recommended application of cemented-carbide tools should be analyzed carefully. Many of the modern machines are designed with enough power to make the heavy cuts possible with these tools, and the strength of the various machine parts is sufficient to permit high cutting speeds without vibration. However, it may be more desirable, because of the condition of the machine or for shop-production reasons, to increase tool life to a maximum by limiting speeds to a point below those recommended for the tools. For example, on one job where it was possible to run a cut at approximately 300 ft. per min. with a tool life of four hours, it was found possible to extend the tool life to four weeks by reducing the speed to 180 ft. per min. This brings the economic use of these tools well within the scope of railroad-shop practice, contrary to the criticism which has frequently been voiced that the machines are not capable of handling the work at the increased speeds recommended with these tools.

One eastern railroad has been investigating the use of cemented-carbide tools for boring tires. This road has been boring tires with high-speed tools at a roughing speed of 60 surface ft. per minute with a 3/32-in. feed and a 1/16-in. to 1/4-in. cut, and a finishing speed of 66 ft. per minute with a 1/16-in. feed and a 1/16-in. cut. It was decided to try cemented-carbide-tipped tools for this job with the result that tires are now being rough bored at approximately 190 surface ft. per min. with a 1/16-in. feed and a 1/16-in. to 1/4-in. cut, and finished at 320 surface ft. per min. with a 1/16-in. feed and a 1/16-in. cut. The economies effected are at once apparent.

If these tools are to be used to the best advantage, special training of operators is necessary. The tools must be carefully ground and honed to obtain the best results. Speeds and feeds must be carefully studied for each material. Generally speaking, lighter cuts, lighter feeds and higher speeds must be used for the best results. When cemented-carbide tools are introduced into a shop, it is advisable to adhere strictly to practices recommended by the tool manufacturer and to train at least one man thoroughly in their use. The machining features of cemented-carbide tools are so radically different from those of high-speed tools that many old ideas regarding machining practice should be forgotten.

Locomotive Inspection Then and Now

In a striking analysis of the results of 25 years of federal locomotive inspection, presented at the March meeting of the Southern & Southwestern Railway Club, John M. Hall, chief inspector, Bureau of Locomotive Inspection, I.C.C., brought out a number of facts which are well worth reviewing for the benefit of readers of *Railway Mechanical Engineer*. According to Mr. Hall,

early proposals for federal locomotive inspection were strenuously resisted, step by step, by many railroads and railroad men who failed to get a clear picture either of the necessity for federal inspection or the benefits which would result. The Bureau was successful in changing this sentiment over a period of years and now, with practically unanimous railroad support, has an enviable record of achievement to its credit, not only in accident prevention, but in promoting a substantially higher standard of locomotive maintenance and performance, with resultant favorable effect on railway earnings.

Reverting for a moment to the past, locomotives built three decades ago were equipped largely with ash pans which had to be cleaned from underneath, with attendant hazards resulting in the death and injury of many employees. The first government regulation, adopted after considerable agitation and strong railroad opposition, was the Ash Pan Act, passed by Congress May 30, 1908, and requiring the installation of ash pans which could be dumped, emptied and cleaned without the necessity of employees going under the locomotives. The practicability and effectiveness of the new law was quickly demonstrated by the complete elimination of this particular type of casualty.

Similarly, frequent explosions and other accidents due to the use of defective boilers and appurtenances resulted in casualties which created a demand for federal regulation of boiler conditions, and the Boiler Inspection Act was eventually passed by Congress and made effective July 1, 1911, establishing a Bureau charged with the responsibility of seeing that the railroads maintained locomotive boilers and appurtenances in proper condition and safe to operate. This act produced the desired results, but, with the concentration of attention on ash pans and boilers, certain other important parts of locomotives, such as the running gear and machinery, were more or less neglected, and consequently the Boiler Inspection Act was amended March 4, 1915, to extend the jurisdiction of the Bureau over the entire steam locomotive and tender, this amended act being generally referred to as the Locomotive Inspection Act. Still one further extension of authority was granted on June 7, 1924, when the jurisdiction of the Bureau was extended to include locomotives propelled by power other than steam.

The results of the Locomotive Inspection Act, as amended and enforced in the intervening years since its first passage, are well known and a matter of public record. Mr. Hall credits the act with preventing 1,622 deaths and 14,695 injuries, or a reduction of 64.7 per cent in the number of deaths and a reduction of 48.9 per cent in the number of injuries that would have occurred if casualties had continued at the same rate as in the first year the act and the amendments were effective. He says that these estimates, moreover, do not take into consideration the large, but indeterminate, reduction in killed and injured, caused by the practical elimination of steam leaks which obscure the view of enginemen.

Mr. Hall closed his paper with the following pertinent comments: "As I have tried to show in my paper, while there was considerable antagonism and lack of co-operation in the earlier days, that antagonism has largely disappeared and we now have the sincere co-operation of the railroads. They are working with us in an endeavor to maintain locomotives in such condition as to prevent accidents. I believe I am also safe in saying that we now have the sincere co-operation of practically every mechanical officer in the United States.

"I am also convinced that the managements of the railroads have come to realize that instead of the Bureau being a hindrance, inspection by the federal government is really helping them not only to operate safer equipment, but keep locomotives in better condition, which means economy in operation, fewer failures and fewer accidents, and, at the same time, conservation of life and limb, thus making the railroads the safest means of transportation from one end of the U. S. A. to the other."

New Books

United States Regulations for Steam and Other than Steam Locomotives. *Published by Gibson, Pribble & Co., Richmond, Va. 218 pages, 6½ in. by 4 in. Price, $1.25.*

Four government booklets, completely indexed as one, are brought together in this book. They are the Laws, Rules, and Instructions for Inspection and Testing of Steam Locomotives and Tenders; those for Other than Steam Locomotives; Interpretations, Rulings and Explanations on Questions Raised relative thereto, as prescribed by The Interstate Commerce Commission. Bureau of Locomotive Inspection, and Safety Appliance Standards for Locomotives as Fixed by Order of The Commission, dated March 13, 1911.

Vanadium Steels and Irons. *Published by the Vanadium Corporation of America, 420 Lexington avenue, New York. 189 pages, illustrated. Bound in flexible leatherette. Price, $1.25.*

Vanadium Steels and Irons is a review and reference source for the chemical composition, physical properties, heat treatment, recommended applications and fabricating procedure of all irons and steels in which vanadium is an alloying element. Structural steels for light and heavy sections, S. A. E. alloy and related high-test steels, spring steels, cast steels, tool steels and nitriding steels are treated comprehensively, with complete data on physical properties and heat treatment. In each case conditions under which most favorable service results can be expected are specifically outlined and suggestions made for correlating the choice of alloy steel and its heat treatment with the fabricating procedure to be used. Charts and tables are based on the latest authentic tests and analyses. Bibliographic references under each chapter head include a great deal of new work, and a special chapter is devoted to a consideration of high-test alloy cast irons.

Gleanings *from the* Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

Management Employee Relationships

A higher standard of living does not mean a more contented people. Quite the reverse. In fact, discontentment is the driving force that creates desires beyond bare necessities. Therein lies the answer to the apparent contradiction between present labor unrest and the highest standard of living the world has ever known. Wise executives recognizing this will give the full measure of attention that employee relationships need.

Valve Repairs and Adjustments

The article about valve repairs and adjusting, as developed in the West Albany shops, in your April issue, is the most practical discussion on the matter I have ever read, and should be worth many dollars to the shop official who takes advantage of the information given. There is only one defect that could exist after an overhaul of the valves and valve motion, as described, and that would be in the steam passages of the cylinder casting. I made an unsuccessful attempt to interest a general foreman in a somewhat similar system as far back as 1911, but the art of welding was not far advanced then, and the shop was really too small to handle the methods to advantage.

Pensions?

What is happening in Washington about the payment of railroad pensions? According to all reports, the railroads and the labor unions came to an agreement on this question and we understood, also, that adequate legislation had been enacted to set the machinery for the new pension system in motion. Some of our men who have applied for pensions say they have not even received an acknowledgment, although several weeks have elapsed since they presented their claims; others who filed applications many months ago under the provisions of the 1935 act are harsh in their criticisms over delay in handling their cases. Presumably it will take much time and patience to set up the elaborate and extensive organization which will be required for handling railroad pensions; on the other hand, when the 1935 pension act, which has now been superseded, was adopted, an organization was set up which, up to the end of 1936, made about 2,100 annuity grants. What is holding up things now?

Responsibility for Excessive Slack

You have discussed in your columns the handling of passenger trains, but the writer does not recall seeing anything bordering on a frank discussion of the responsibilities of the car department for excessive slack in passenger-car couplers and draft attachments. You know the effect of this sort of thing on the comfort of passengers—and you know, too, that these remarks are not aimed at any one railroad, because you travel around a bit and have your rest disturbed the same as the rest of us; so why not shake up the car maintenance forces in your column? Oh yes, we all know that the car designers have concealed the draft gear so neatly that nothing short of X-rays can inspect it unless it is taken down. But why not feelers, peep holes, gages, or something else worthy of the intelligence and ingenuity of the car foreman? And don't tell us that the transportation people won't cut the cars to the shop track. They cut 'em out when a wheel is condemned. And are draft gears always given the attention they require when the car is actually on the shop track for other work?

Condensation in Box Cars

What is the latest word about the prevention of condensation in box cars? Here is an old, old problem that we don't seem to make much progress in solving, in spite of the great amount of damage that is being done to certain types of lading. Not only do the railroads have to pay the claims, but the irritation caused to the shippers does not help at all to make them more friendly to the railroads. I know that many schemes and devices have been tried out, but in our own experience there is still too much of such condensation. According to the statement made by W. L. Ennis, manager of refrigeration service and claim prevention of the Chicago, Milwaukee, St. Paul & Pacific Railroad, at a meeting of the Car Foremen's Association of Chicago last year, "this class of damage is increasing. It is very bothersome, because it is difficult to arrive at the measure of damage."

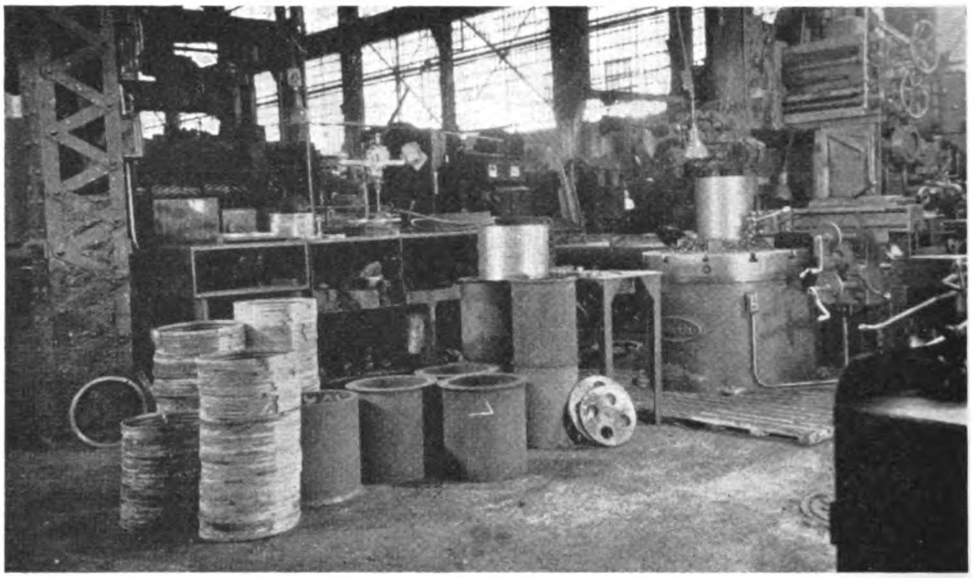
The Boiler Department Problem

The outstanding need in the successful operation of the boiler department today is not tools, equipment or machinery; it is men, or rather young men—apprentices who are sufficiently interested to be developed in the fine arts of the trade. With improved methods and tools making for easy ways of doing what used to be hard work, our younger men have lapsed into a lethargic state of thinking that anything that requires real work is unnecessary. The question is asked daily in every shop where construction work is done: "Who is going to take the lay-out job when the present lay-out man quits, or is pensioned—who is going to be the next flanger, boiler inspector, assistant boiler foreman and general boiler foreman?" There are many wishers who would be glad to take any of these jobs, but where is the young man who will apply himself studiously, long enough to qualify even to start on any of the jobs listed?

Boiler making is still a man's job, if taken seriously, and requires much more ability than the operation of a torch or an electric arc. Within the next ten years nearly all of the present supervisory forces will have passed on, in one way or another, and the serious problem will be to replace these seasoned men, who have spent all their working life at the trade. Let's not try to laugh this off, as we all want to turn over our stewardship to experienced men who will be able to carry on in a creditable manner. The opportunities are great at this time for younger men who aspire to become all-around boiler makers, lead men and foremen, but to get this message over seriously seems almost an impossibility.

Most all of our young men want to cut or weld, or do something easy—they want to make it in one jump. The long, tedious trail does not enchant the younger set today, but the detail work necessary to the successful development of real mechanics has not changed a great deal. There is no short cut to knowledge; experience is still the teacher, and if we can really impress this on our apprentices now we will have started in the meeting of a future great need for the boiler department, in which we have taken such pride and have made our life's work. Boiler department apprentices and younger boiler makers, please answer this question: "Who will fill the Old Man's shoes ten years from now; will you prepare yourself to be one of them?" The above is written not by an old man, but by a boiler maker who learned the trade by hard work and has spent 40 years at it, from heating rivets to filling the Old Man's shoes.

IN THE BACK SHOP AND ENGINEHOUSE



Quantity Production of Piston-Valve Packing Rings

The "L" type packing ring shown in Fig. 1 is used generally for locomotive piston valves on the New York Central and the production of these rings has been concentrated as shown above, at the West Albany shops of the railroad. Fig. 1 shows a detailed description of the ring which is made in various sizes for valves from 10 in. up to 16 in. diameter, and in step sizes beginning with the nominal diameter of steam-chest bushings and increasing in step sizes of $\frac{3}{32}$ in. until the maximum diameter of $\frac{3}{8}$ in. over nominal is reached when the bushings are replaced with new ones having the nominal diameter. This system of step sizes has been developed after exhaustive study as to the amount of enlargement necessary to rebore valve bushings to overcome wear

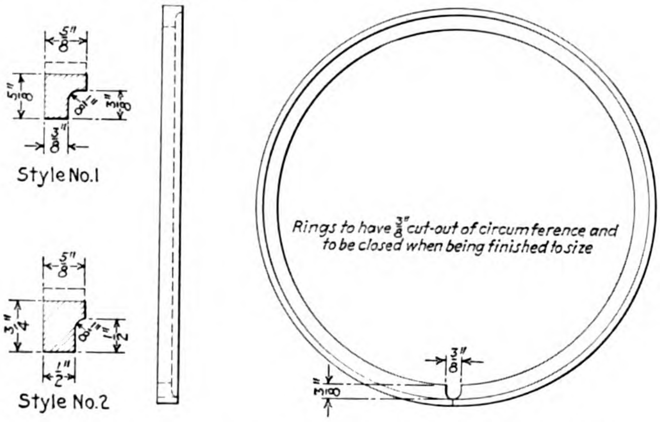


Fig. 1—The two styles of valve rings used on the New York Central System

and the increased sizes are above nominal diameters as follows: $\frac{3}{32}$ in., $\frac{3}{16}$ in., $\frac{9}{32}$ in. and $\frac{3}{8}$ in.; at the latter size the bushings are renewed after nominal service.

The packing rings are made of gun iron or its equivalent, which is furnished in castings or ring blanks of a height sufficient to produce 18 finished rings. The casting has a 45 deg. beveled chucking collar, as shown in Fig. 2, and also as the second operation in Fig. 4, which provides excellent chucking facilities since it tends to

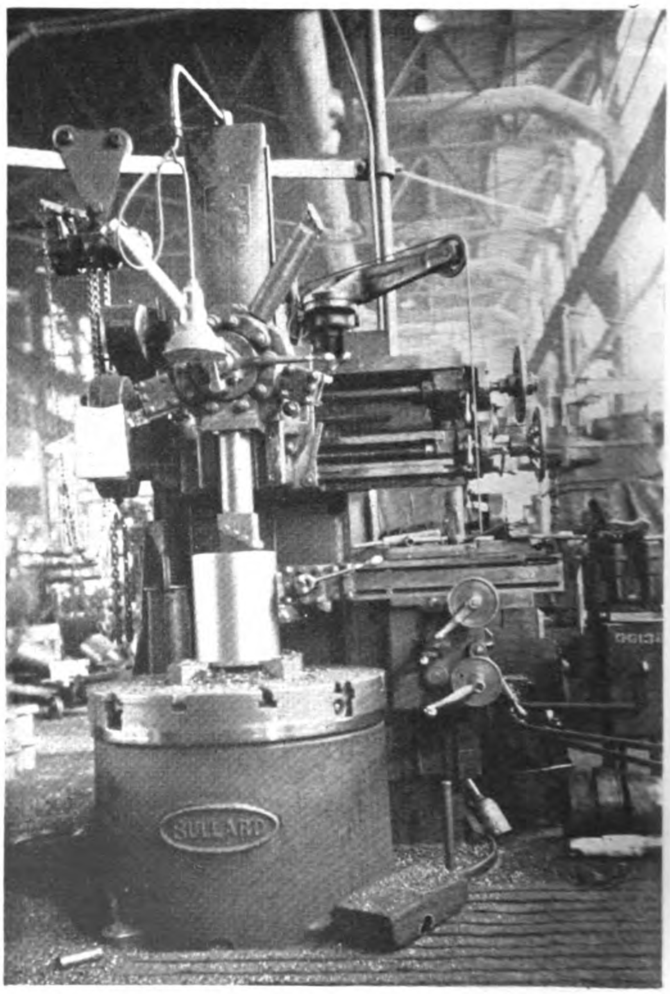


Fig. 2—Vertical turret lathe finish turning the valve-ring pot

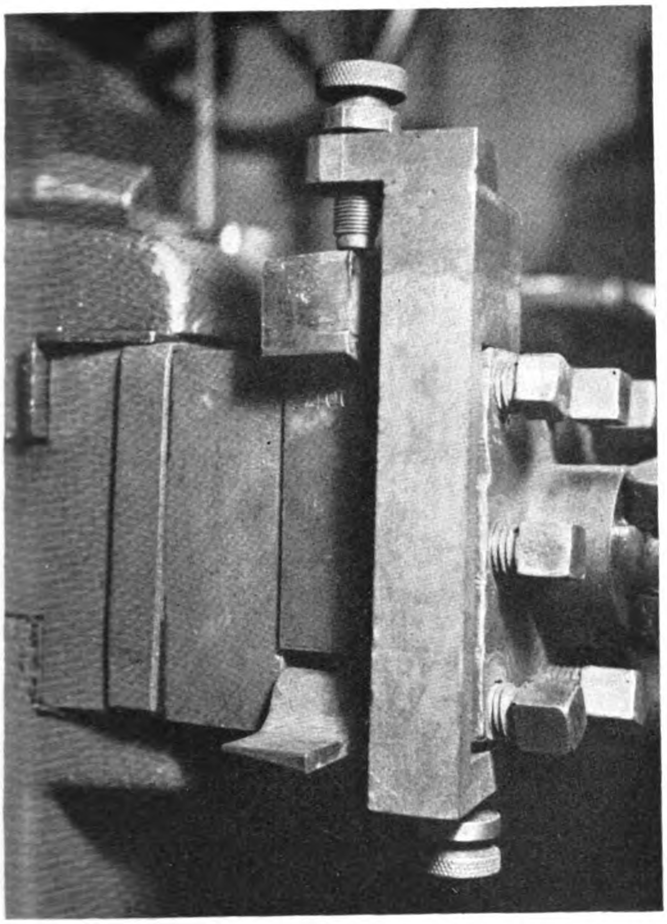


Fig. 3—The gage used to set up the finishing tool—After the cutting edge of the tool is set against the face of the adjusting screw shown at the top and the tool is tightened in that position, all finish cuts are made with the micrometer dial on the side head rather than by calipers —Note scribe marks line-in-line on the adjusting screw and body

hold the casting securely in place while machining and also wedges the casting down on parallels provided on the inner end of special chuck jaws made for this operation.

The rings are turned, bored, faced, recessed and parted from the casting on a 42-in. vertical turret lathe after which they are ground on the flat side to a snap-gage size on a 30-in. motor-driven rotary grinder. The ring is then drilled for dowel clearance, sawed and expanded on a finishing bench.

Method of Production

The ring blank is placed on the vertical turret lathe and chucked, using a special self-centering device. The first machining operation is to face the top of the casting, using a Stellite-tipped facing tool. Then the casting is rough turned and rough bored, as shown in the first operation in Fig. 4, at a surface speed of approximately 80 ft. per min. and a feed of 0.068 in. per revolution, using Stellite-tipped tools for both operations. Sufficient stock is left for a finish cut on the inside and outside of the casting. The outside finishing cuts are made with Stellite-tipped tools at a surface speed of 80 ft. per min. and a feed of 0.083 in. per revolution. The outside of the ring is turned $\frac{1}{32}$ in. + 0.006 in. oversize and bored $\frac{3}{64}$ in. oversize. The reason for boring $\frac{3}{64}$ in., or $\frac{1}{64}$ in. above the $\frac{1}{32}$ in. oversize, is to insure clearance for the division ring, valve body and follower in the event it is necessary to file the joint in fitting the ring to the valve bushing. This method also produces a ring of equal cross-sectional area throughout its entire circumferencial length.

The rough and finishing tools in the side head of the machine are set up with the gage shown in Fig. 3, which gage enables the operator to set the tool in the side head always in the same position with respect to the zero reading on the side-head micrometer dial. With the tool always in the same position in the side head, the operator is able to obtain sizes without the use of calipers, the size being taken from the micrometer dial on the side head. The gage for adjusting the outside finishing tool is originally set in the following manner: A bushing is placed in the machine and turned to a micrometer size of 6 in., after which the tool is placed in the side head and clamped against the work with the micrometer dial on the side head set at zero. The adjustable screw on top of the gage shown in Fig. 3 is then set against the cutting edge of the tool. From then on the tool is always replaced in the side head with the cutting edge against the screw adjustment of the gage, thus locating the cutting edge of the tool always in the same position with respect to the side-head mi-

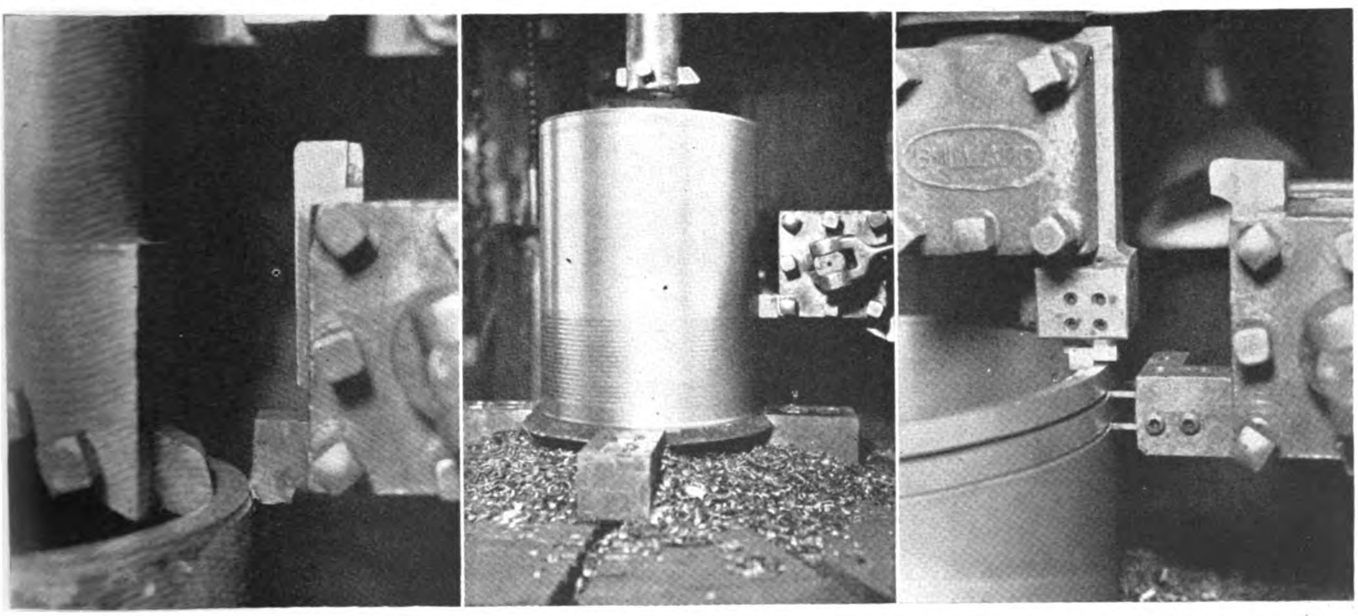


Fig. 4—Left: First operation, rough boring and turning the pot—Center: Second operation, finishing the outside of the pot—Right: Third operation; facing, recessing and parting the valve rings

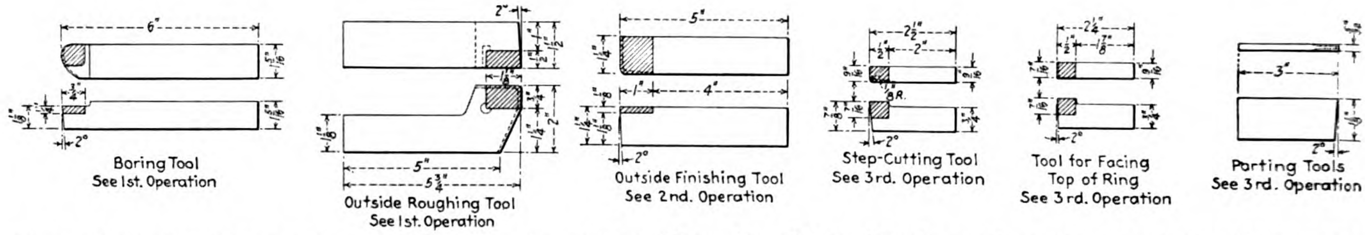


Fig. 5—Stellite-tipped tools used in valve-ring production at West Albany—From left to right these tools are the boring tool, outside roughing tool, outside finishing tool, step-cutting or recessing tool, facing tool, and all-stellite parting tool. The operations refer to Fig. 4

crometer dial set at zero. Finish sizes above or below 6 in. are then made directly by the micrometer dial rather than by the use of calipers.

After the finishing operations are completed the ring is recessed and faced on top using the set up of recessing and facing tools held in a gang holder placed in one of the tool holders in the turret on the main head as shown in the third operation in Fig. 4. While recessing and facing is being performed with the main head, the ring is parted from the casting, as also shown in the third operation in Fig. 4, with a gang of two 5/32-in. Stellite parting tools held in a special gang-tool holder placed in the turret tool holder on the side head, one tool being set 3/8 in. ahead of the other one to part one ring while the other tool is grooving the casting for the next parting operation. The surface speed of these operations is approximately 64 ft. per min. using a feed of 0.011 in. per revolution. The tools used in all the operations are shown in Fig. 5.

After the ring is parted from the casting, a serial number, 1, 2, 3, 4 or 5, depending on the size of the ring, is stencilled on the finished face of the ring to indicate the size. These serial numbers are used in place of ring sizes in order to eliminate excessive stencilling; No. 1 indicates a ring of nominal diameter; No. 2 indicates a ring 3/32 in. above nominal; No. 3 indicates a ring 3/16 in. above nominal; No. 4 indicates a ring 9/32 in. above nominal and No. 5 indicates a ring 3/8 in. above nominal diameter.

Fig. 6—The rotary surface grinder used for grinding the plain side of the rings to snap-gage dimensions

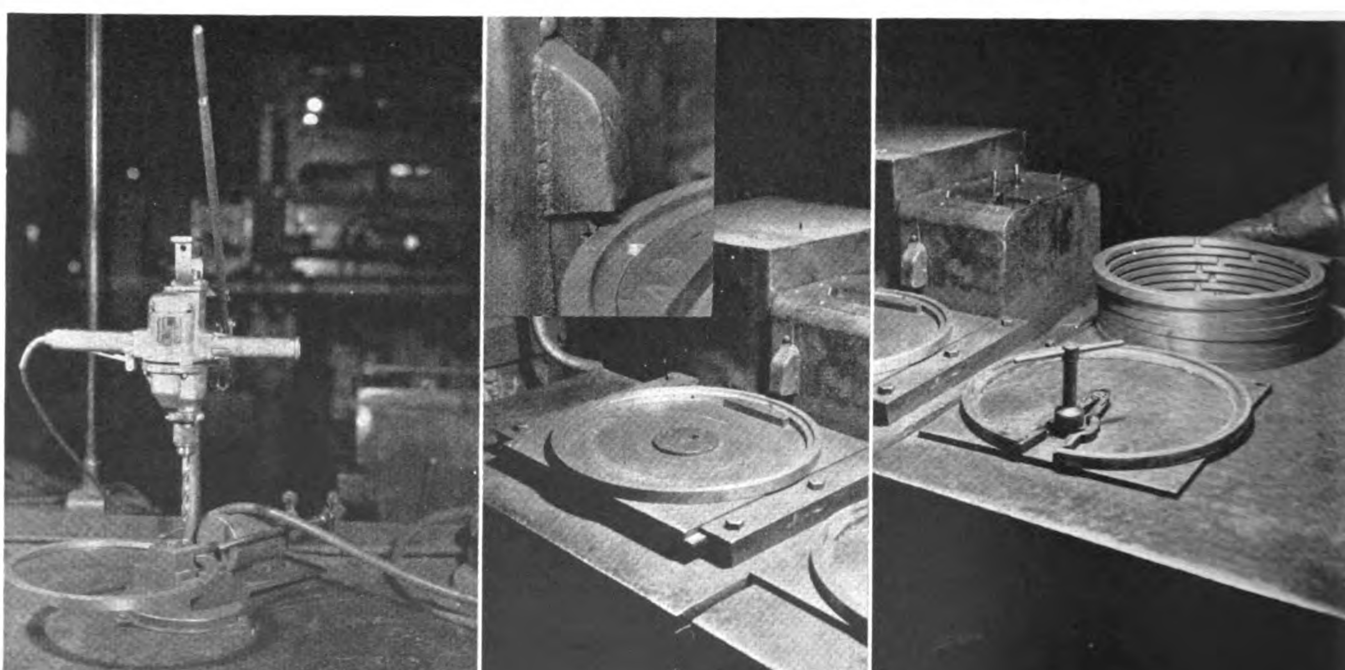


Fig. 7—Left: Drilling the rings for dowel clearance—Center: Sawing the ring at the dowel-clearance hole; the insert is a close-up of the saw blade and guard—Right: The ring expander which expands the ring to approximately a 3/8-in. opening when at rest position. All these operations are performed on the bench shown at the left in the photograph at the head of this article

Three rings are then placed in one setting on a 30-in. rotary surface grinder, which is shown in Fig. 6 and ground on the plain side to snap-gage dimensions, using a soda-ash coolant, after which it is dipped in a tank of soda-ash solution to wash off all grindings and protect it from rust and corrosion. A ½-in. hole is then drilled in the ring for dowel clearance, using the electric bench drill and the pneumatically clamped drilling jig shown as the first operation in Fig. 7. The clamp is foot-operated from the floor. After drilling, the ring is sawed through the center of the ½-in. dowel-clearance hole with the ⅛-in. saw shown as the second operation in Fig. 7, which sawing leaves ⅜ in. for clearance over the 5/16-in. dowel in the division ring in the valve assembly. The saw feed is actuated by a foot lever while the operator holds the ring in the sawing jig.

As noted previously in this article, the rings are turned 1/32 in. or 0.03125 in. oversize in diameter, which produces an oversize of 0.098 in. in circumference. The ⅛-in. saw cut leaves a clearance between the ends of the rings of approximately 0.027 in. when applied to a valve bushing with no plus or minus variation from nominal size. Specifications call for an opening of from 1/64 in. to 1/32 in. between ends of the ring when in position in the valve chamber. To produce this result the ring, after being sawed, is expanded in the expanding device, shown as the third operation in Fig. 7, which is operated on the cam principle. This provides a snap action which expands the ring to an opening of 2 in. in the cut and gives the ring an opening of approximately ⅜ in. when at rest position. This produces a tension in the ring which requires a pressure of approximately 60 lb. to close the ring opening when pressure is applied at points 90 deg. each side of the opening.

With the facilities heretofore mentioned it is possible to produce approximately 80 rings per eight hours on one machine. The rings are then placed in stock in the stores department from where they are distributed to all points on the entire system.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Shearing Strength of Welded Joints

Q.—Will you kindly give me an illustration on how to figure the shearing strength of a welded joint, especially spot and intermittent girth and head welds.—F. K. M.

A.—The strength of a welded joint depends largely upon the quality of the weld and the ability of the welder. The strength of a welded joint cannot be computed as in the case of a riveted joint. Therefore it must be based on actual tests.

A series of shear tests for welds made by Andrew Vogel, General Electric Company, Schenectady, N. Y., are summarized as follows:

A series of twelve specimens were made in accordance with recommended practice of the Committee of Standard Tests for Welds (American Welding Society). The series was divided into four groups of three specimens each, four welders of average ability were selected and each welder was directed to weld a group of three specimens. No special instructions were given, in order that the welds should indicate the average ability of each welder.

The tests were made in the usual manner and the results are recorded in the table below:

Specimen	Total Stress	Stress per linear inch of weld	Average stress	General average stress
A-1	75,750	12,625		
A-2	81,300	13,550	13,217	.....
A-3	80,850	13,475		
B-1	81,400	13,567		
B-2	72,600	12,100	12,947	.....
B-3	79,050	13,175		
				13,252
C-1	88,050	14,675		
C-2	80,600	13,433	14,314	.....
C-3	89,000	14,833		
D-1	76,750	12,792		
D-2	76,700	12,783	12,536	.....
D-3	72,200	12,033		

It will be observed that the total load varies from 72,200 to 89,000 or from 12,000 to 14,000 lb. per linear inch. The welds were of average quality such as commonly used, and as a design value of 3,000 lb. per linear inch for ⅜-inch weld is used, the result is a factor of safety of four or more.

Shielded-Arc and Arc Welding

Q.—What is shielded-arc welding and how does it differ from arc welding?

A.—Shielded-arc welding differs from arc welding in that a shielded arc is obtained through the use of specific types of electrodes which are heavily coated. The heavy coat is of such composition that in the heat of the arc it gives off large quantities of gas which envelops and completely shields the arc from the ambient atmosphere.

The electrode coating is consumed in the arc at a slower rate than the rate of deposition of the electrode metal. As a result of this the coating extends beyond the metal core of the electrode and serves to direct and concentrate the arc stream.

The action of the arc on the coating of the electrode results in a slag formation which floats on top of the molten weld metal and protects it from the ambient atmosphere while cooling. After the weld metal is sufficiently cooled the slag may be easily removed.

It is common knowledge that molten steel has an affinity for oxygen and nitrogen. When exposed to the air molten steel enters into chemical combination with the oxygen and nitrogen of the air to form oxides and nitrides in the steel. These impurities in the steel tend to weaken and embrittle it as well as lessen its resistance to corrosion.

In the ordinary arc the molten globules which pass from the electrode to the work are exposed to the ambient atmosphere which contains chiefly oxygen and nitrogen. The molten base metal is also exposed to these elements. They combine with the molten metal forming oxides and nitrides in the weld metal. If the metal during the fusion process is completely protected from contact with the ambient atmosphere the injurious chemical combination cannot take place. This can be achieved by completely shielding the arc.

An arc may be shielded by completely enveloping it with an inert gas, which will not enter into chemical combination with the molten metal and at the same time prevent its contact with the atmospheric oxygen and nitrogen. Welds made with a completely shielded arc

are largely free of oxides and nitrides and are therefore composed of metal having superior physical characteristics to that deposited by an ordinary arc. For example, welds made with a shielded arc have a tensile strength of 60,000 to 80,000 lb. per square inch which is 20 per cent to 50 per cent higher tensile strength than that possessed by welds deposited by an ordinary arc. The ductility of welds made with a shielded arc averages 100 per cent to 200 per cent greater. The resistance to corrosion of shielded arc welds is greater than even mild rolled steel and far greater than that of welds made with an unshielded arc.

The Life of Boiler Tubes

Q.—How is the life of a locomotive boiler tube usually determined?—M. T.

A.—The Interstate Commerce Commission Bureau of Locomotive Inspection, Laws, Rules and Instructions for inspection and testing of steam locomotives and tenders and their appurtenances, Rule 10, states, in part:

Flues to be removed—All flues of locomotive boilers in service, except otherwise provided, shall be removed at least once every four years, and a thorough examination shall be made of the entire interior of the boiler. After flues are taken out the inside of the boiler must have the scale removed and be thoroughly cleaned. This period for the removal of flues may be extended upon application if an investigation shows that conditions warrant it.

When tubes are removed from the boiler they should be examined for surface defects and so far as possible shall be free from depressions caused by scale or scoring.

The tubes deteriorate more rapidly at the ends toward the fire, and they should be carefully tapped with a light hammer on their outer surface to ascertain whether there has been a serious reduction in thickness. The condemning limit of tubes is usually determined by weight. This weight varies somewhat at the different shops, the weights given below being an average.

Tubes and flues are to be weighed and those meeting weight, shown in the following table, are to be welded and used on any locomotive:

Outer Diam. In.	Nearest B.W.G.	Decimal Thickness B.W.G.-In.	Minimum Weight Lb. per Ft.
1¾	12	0.109	1.57
1¾	11	0.120	1.57
2	12	0.109	2.05
2	11	0.120	2.05
2¼	12	0.109	2.31
2¼	11	0.120	2.31
2½	12	0.109	2.56
2½	11	0.120	2.56
3¼	11	0.120	3.56
3¼	10	0.134	3.56
3½	12	0.109	3.66
3½	11	0.120	3.66
5¾	9	0.148	7.51
5½	9	0.148	7.75

Protecting Tubes Against High Temperatures

Q.—What practical steps may be taken to enable boiler and superheater tubes to withstand higher temperatures?—C. C.

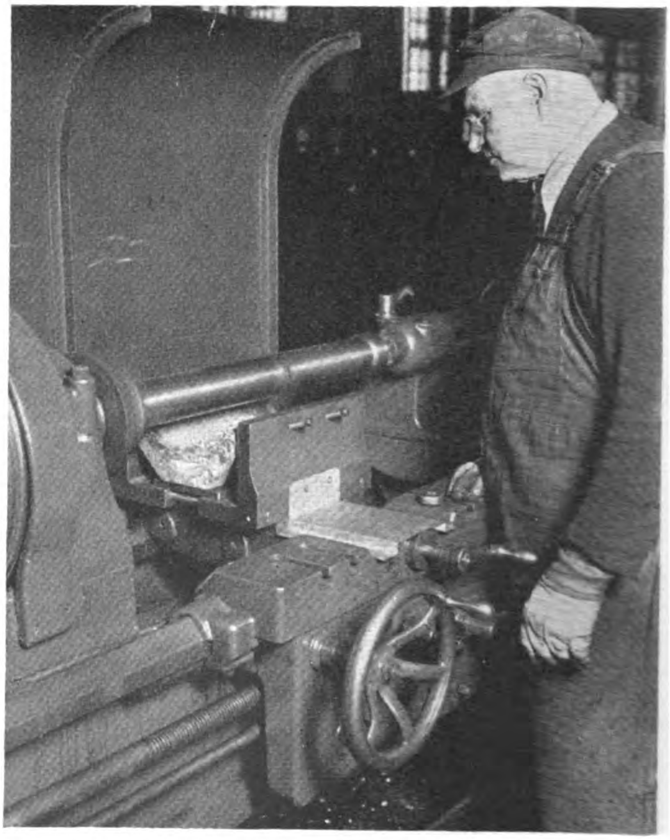
A.—There are various possibilities. One is the use of tubes made of special alloy steel, usually containing some chromium, which is heat resistant and has less creep than the ordinary steels. Such special tubes will withstand higher temperatures with less loss of strength and tendency to blister. Another is coating the outside of fire tubes with aluminum (calorizing). This thin coating appears to give some protection of the metal against high furnace temperature. It has been used on tubes of mercury boilers and is employed sometimes on superheater and fire tubes. The most obvious thing, however, is to maintain the water or steam surface clean and absolutely clear of all deposits. This is secured by having a smooth interior surface and by suitable chemical treatment of the boiler water.

Jig for Boring Truck Brasses

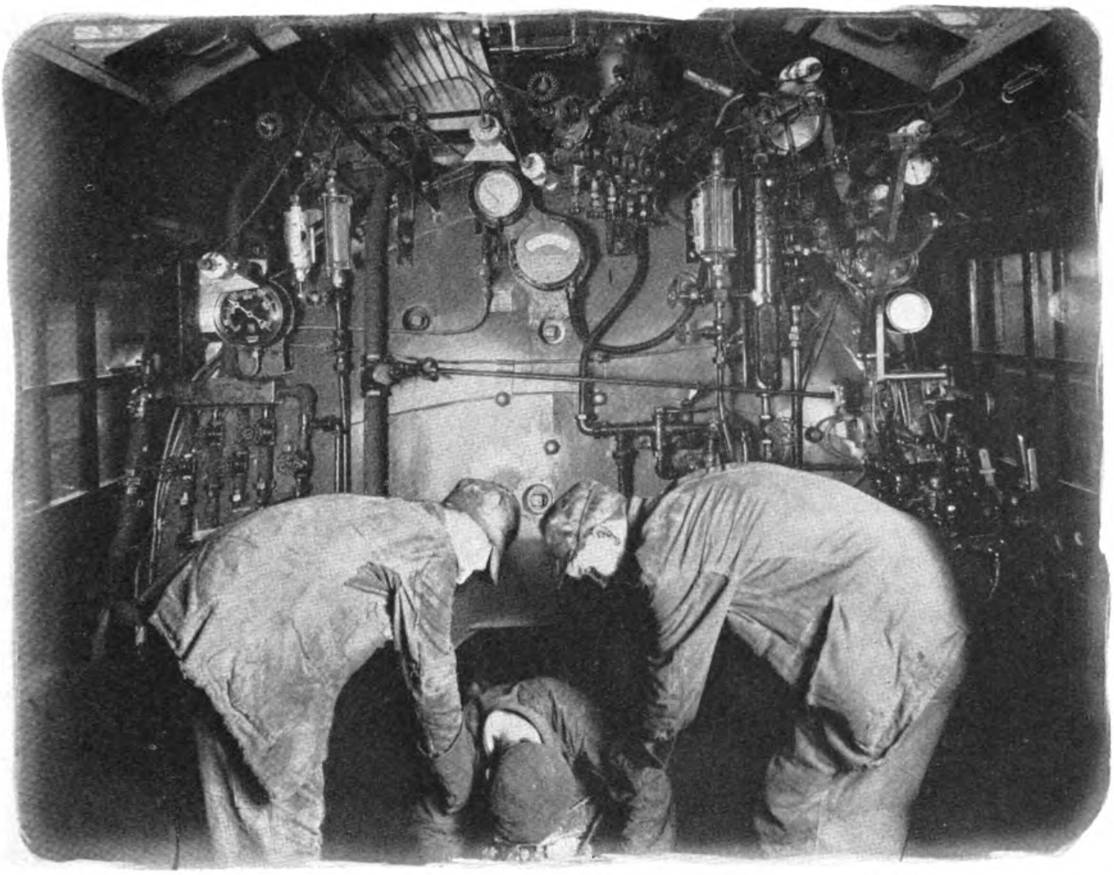
A well-made chuck, or jig, for holding engine-truck brasses while being bored in an engine lathe, is shown in the illustration. This lathe chuck attachment, now being used at the Chicago & Eastern Illinois shops, Danville, Ill., consists of two accurately finished, hardened-steel, angle brackets, which slide on the cross-carriage V-ways, and are connected to the cross-feed screw by right and left nuts, which make the brackets self-centering with respect to the lathe-spindle center line.

The engine-truck brass rests on a steel plate of the proper thickness to leave a maximum amount of bearing metal permissible at the crown. A turn of the cross-feed screw quickly centers the brass and holds it firmly during the boring operation, two angle set screws in each bracket being provided as an extra precaution against the brass working loose in the jig during the boring operation which is performed by a stationary boring-bar cutter, set to the proper radius and revolved while the longitudinal feed of the lathe carriage is engaged.

The rather neat galvanized-iron chip guard, applied over the cross-feed screw and attached to the nearer angle bracket so as to move with it, is clearly shown in the illustration. The chip guard at the back of the engine lathe also is of an unusually neat and satisfactory design. It is estimated that the use of this special chuck, or jig, effects a saving of at least 15 per cent in the cost of boring engine-truck brasses as compared with the method formerly used.



Engine lathe equipped with special chuck or jig for boring truck brasses



The fire builder and the boilermaker helper dragged Barton out of the firebox

HOT WORK

By

Walt Wyre

It's the private opinion, often publicly expressed by members of other crafts in railroad roundhouses, that boiler makers are more or less a necessary nuisance and not so very necessary. The idea started when electric welders did away with the use of bran, sawdust, horse manure, and other panaceas for leaky flues. At that, engines with leaky flues were the rule rather than the exception, and a locomotive without a few plugged flues was almost unheard of.

In those days a favorite theme of fiction writers was about the heroic fireman that crawled in a hot fire-box to stop a leaky flue with a plug cut from a green sapling along the right of way and thereby got the train over the road in time to save the mail contract for dear old wooden axles. Incidentally, the beautiful daughter of the superintendent, or maybe it was the president's, was always handy at the end of the run to pillow the fainting fireman's head in her lap and soothe his blistered brow with kisses so hot they drew the fever out of the burns.

It took a lot of boilermakers to keep the leaky kettles calked so they would make a run over a division without putting the fire out. In many instances boilermakers outnumbered machinists. Good boilermakers were in demand and ones that wanted to work seldom out of a job.

It's different now. Leaky flues are as rare as sweat from a relief worker's brow and a fireman would let a locomotive on the president's special die dead as the League of Nations before he would crawl in a fire-box unless the fire-box was air conditioned.

But because steam failures are infrequent and there are not so many boilermakers, members of other crafts have gotten the idea that about all boilermakers are good for is to make a lot of noise and keep the acetylene torches tied up all of the time.

Boilermakers may not be as numerous as before, but they are just as necessary for the operation of locomotives and they're doing a better job. True, electric welders and treated water have reduced the amount of boiler work required, but higher steam pressures, longer runs, and more rigid requirements by the I.C.C. make better work necessary. No longer is any job that will hold water in a boiler considered good enough. That's only the first consideration. It must be done according to exact specifications. That's the rule, and it's seldom violated. Only on occasional exceptions in an emergency a boilermaker may do a job not according to standards. Sometimes such jobs get by; more often than not, they don't; then somebody gets all torn up like a sow's bed.

Jess Horton, a boilermaker for the S. P. & W. in the

roundhouse at Plainville, was making a monthly inspection and test on the 5091. Jim Evans, the roundhouse foreman, was walking circles around the locomotive wanting to know when he could take a call on it. The instant the last washout plug was tightened and the fill-up hose connected, Evans beat it to the roundhouse and called the dispatcher.

"It'll be the 5091 on the second fruit train," the foreman said.

"O.K.," the dispatcher replied. "I was just wondering if you were going to have an engine. It'll be at 4:30."

"Wow!" Evans exploded. "Can't you give us a little more time on her? It's almost three o'clock now and no fire in the engine yet."

"Well, make it five o'clock, and that means leaving at five," the dispatcher said.

Evans hung up the receiver and rushed back to the roundhouse. "Get a fire going in the 5091 the minute she shows a gage of water and crowd her all you can," the foreman told the firebuilder.

At 3:45 Evans climbed in the cab to see how the 5091 was coming along. The gage showed twenty-five pounds of steam and the oil burner was going good. Pressure would climb rapidly from then on. He gave a sigh of relief, bit a corner off a plug of "horseshoe" and climbed down from the cab. After a turn through the house, he went back to the office.

At 4:10 Horton burst into the office like an overdue accident looking for a place to happen. "The 5091—it's got a washout plug leaking!" the boilermaker panted.

"What!" Evans snapped. The front legs of his tilted chair hit the floor with a bang.

"Yeah," Horton replied dolefully, "it's leaking pretty bad."

"Can't you tighten it?" the foreman asked hopefully.

"I pulled on it pretty hard—didn't help any," the boilermaker told him.

"Hell fire, man, she's called for 5:00 and the superintendent sitting with a watch in his hand waiting to eat me up if there's a minute delay! Ain't there something you can do?"

"I'll try again," Horton said in a hopeless tone and left the office. Evans followed him to the roundhouse.

The boilermaker heaved on the long handled washout plug wrench. If anything, the hissing jet of steam around the plug increased. "Hand me a piece of pipe," Horton told his helper.

Increased leverage of the piece of pipe on the wrench handle did no good. "It's no use." The boilermaker shook his head.

"Ready to go?" It was the hostler come to take the engine out of the house.

Evans fished nervously in his jumper pocket for his plug of "horseshoe." "Not quite," he said to the hostler, "may have to blow her down," he added.

"Pitch me a calking chisel and hammer," Horton told his helper. "All right, it's not leaking now," the boilermaker announced a few minutes later.

There was no delay leaving Plainville and the plug didn't leak, but a government inspector slapped a Form-5 on the 5091 at Sanford, the next division point. How the inspector happened to see the calked plug is still a mystery, but he saw it, and the fruit train was held over an hour getting another engine ready.

At the investigation, Evans was forced to admit that he didn't tell Horton to calk the plug. The boilermaker was out of service thirty days despite the foreman's protest.

That was one that didn't get by even though motivated by the best of intentions. It does show that boilermakers are loyal and conscientious in their work sometimes even to the point of risking their jobs. Horton knew it was a violation to calk a washout plug.

SOMETIMES a boilermaker will even go further and jeopardize his own safety to prevent delay or failure in emergency, like Henry Barton did on the 5088. The safety rule book says that in all cases work must be performed in a safe manner, but even the officials that compiled the rules must admire the nerve of a man that will deliberately torture himself in a fire-box hot enough to broil a steak with a chance of being scalded with steam from a crack in the firebox wall, even if these same officials don't condone it.

The job Barton did in the fire-box of the 5088 was just as disagreeable and dangerous and required a lot more skill than driving a wooden plug in a leaky flue, but no one acclaimed Horton a hero. There was no good-looking girl to hold his grimy head and kiss his sooty face when he came out of the fire-box, either. Barton wasn't cut out for a hero, besides he hasn't got the build. Who ever heard of a pot-bellied hero?

Barton does the electric welding for the boilermakers' craft and he's good, too; rated by the welding supervisor as one of the best on the S. P. & W. The only drawback is his figure—if fire-box doors are made any smaller, or Barton's belly gets any bigger, he won't be able to get in a fire-box; it's a close squeeze now.

Business had picked up on the Plains Division, but the monthly allowance for maintenance of equipment hadn't been increased. The boilermaker's force, small enough normally, was having a hectic time trying to keep the work up with force reduced and work increased. Added to that, two engines that had been in storage and due for tests were put in service. Removal of flexible staybolt caps, hydrostatic tests, and other work came very near being straws that overloaded the camel, and the boilermakers were busy as two deaf and dumb women having an argument. Just to cap it off, one of the locomotives had to have a patch on the belly of the boiler and the other required a new neck on a siphon. That, together with the tests being due, were the reasons those particular engines were stored.

The engines were needed badly, but running repairs left little time for men to work on them, and Evans didn't dare work men overtime to get them out. Every mail brought at least one letter advising the foreman to stay within the allowance.

Each day when Evans figured the engine lineup and had enough locomotives to go around, he heaved a sigh of relief. Every day he was afraid at least one train would be without motive power, but somehow they made it.

At last the two locomotives out of storage were finished and Evans breathed freely for the first time in ten days. "Well, with two more 5000's, things don't look so bad," the foreman told John Harris, the clerk.

The office phone rang five minutes later. "Hello . . . Yes, clerk talking." Harris held his hand over the mouthpiece of the phone. "It's the train-delayer—says there'll be a special through here about 7:00 p.m. He wants a 5000."

"All right, give him the 5093." Evans mentioned one of the recently completed locomotives.

Evans finished making out the engine lineup, and had a whole locomotive left over. "We can drop the wheels on the 5087 when she gets in," he said. "Goodness knows, they need it. The driving boxes are pounding like pile drivers and the tires should have been renewed fifteen days ago."

The phone rang again. "Yes, this is the roundhouse

. . . Yes, Evans is right here." . . . "It's the delayer again, wants to talk to you, sounds like he's got a bee in his bonnet," Harris told the foreman.

Evans took the receiver. "Hello . . . Yes . . . What? Where did it happen? . . . All right, the 5086 will be ready to go in twenty minutes." And there was no extra engine.

Evans hung up the receiver. "The 5091 tore herself up—main pin broke," he told the clerk.

"Where did it happen?"

"Going down Clear Creek hill," Evans spoke over his shoulder as he left the office.

The 5091 got in to Plainville about 4:15. She was a wreck—the engine going down hill when the pin broke had almost stripped herself clean on the left side. Besides requiring a lot of work to repair the damage, the left main rod would have to be renewed, and there was none on hand. Evans shook his head dolefully when he looked the locomotive over. It would be a week at least before he could get the parts and have the 5091 back in service.

"Put her over the drop-pit," the foreman told the hostler. "Long as she'll have to be lined up anyway might as well get some of the work she needs done."

In the meantime boilermakers were having troubles of their own. Engines had made "one more trip" too many times and were getting to the point where they would make no more without being repaired. It seemed that every engine that came in needed a new set of brick in the fire-box. Hogheads were complaining that locomotives weren't steaming, front end leaks, oil burners needed adjusting, fire-box door liners needed renewing, and all of the other thousand and one things that can ail the power producing part of a locomotive.

THERE were no more engine failures for several days following but minor delays of five, ten, and fifteen minutes became as numerous as ants at a picnic and just as annoying until it finally got so bad that the vice-president in charge of operation visited Plainville. He was accompanied by the superintendent of motive power, the division superintendent, and half a dozen other lesser officers.

They spent the day in Plainville each vying with the other to see which could ask the most embarrassing questions. Questions were directed at H. H. Carter, master mechanic, but Evans knew he was the one on the pan.

Engine failures and delays came first in line of queries, all ending with the inevitable "why." Costs of turning engines came in with a close second. Before the day was over, they made the foreman feel that an engine failure came under the classification of a major crime and overtime rated with stealing pennies from a starving blind man.

The business car bearing the party of officials was to leave Plainville on 82, a Gold Ball freight called for 5:20 p.m. Evans assigned the 5074, what he thought was one of the best locomotives available for the train. After the engine was worked, the foreman looked the engine over for any possible defects, but he didn't look in the fire-box. If he had, he would have seen a rivulet of water trickling from a hair-line crack next to a seam in the fire-box wall.

The fire builder noticed it when he opened the fire door to throw in a blazing wad of oily waste to ignite the oil, but thought nothing of it. Water oozing from the crack didn't look any worse than other places that he knew would take up when the metal got hot.

At 4:00 the 5074 was setting on the lead ready to go. Davis, the outbound inspector, gave a final look before the crew came on. The hostler had killed the fire and shut off the blower. Davis noticed a cloud of steam coming from the peep hole in the fire-box door. He opened the door and a cloud of steam billowed out. The inspector didn't wait for a second look. He rushed to the office in search of Evans.

Evans looked in the fire-box and went to find Barton. The tiny hair-line crack in the fire-box wall had opened up under the two hundred and fifty pounds steam pressure Barton discovered when he cleared the fire-box by turning on the blower.

Evans swore fervently and fluently five minutes without repeating or stuttering. There wasn't another engine available that could be made ready in less than two hours. The foreman's rear end would look like a hunk of Swiss cheese by the time the officials finished eating on him.

After exhausting his vocabulary of profanity, Evans felt a little better. "Well, I guess we'll have to run her back in the house and blow her down," he said. "You can't do anything with it, can you?"

"I can try." Barton spoke in a matter of fact tone. "Bring me a calking chisel and hammer and string the welder leads out here," he added to his helper.

"You're not going in that fire-box and calk a leak with over two hundred pounds of steam on it," Evans told the boilermaker. "Besides, you couldn't calk it so it would hold."

"No, but I might weld it," Barton said. "Will you have a couple of laborers bring me half a dozen fire-brick to stand on?"

While the boilermaker helper was stringing out the welder leads, Barton opened a blow off cock and let the steam pressure go down to a hundred and twenty-five pounds. He threw the brick inside the fire-box and sprayed the firedoor ring with water.

As Barton wriggled through the fire door, there was a smell of scorching cloth. The raveled bottom of an overall leg burned as it dragged over the splash wall. When the welder cable was dragged into the fire-box, the acrid odor of burning rubber mingled with other smells in the cab.

"Gimme a hammer and chisel," Barton said.

Standing to one side to escape the rush of steam from the crack, the boilermaker calked the lower portion of the crack. He then ran a bead of weld over the place he had calked.

Calking and welding, he worked. Perspiration ran from his face in a stream. Steam from clothing soaked through with sweat mingled with that from the crack in the fire-box. Barton stumbled. His hand dropped to the hot brick on the side of the fire-box. The leather in the palm of his canvas glove wrinkled from the heat.

When the heat became unbearable, Barton would stick his head in front of the open fire-box door for a reviving breath of fresh air.

Painfully slow, it seemed the leak became smaller until only about two inches remained to weld. It was the most stubborn of all. The weld refused to stick over the rushing jet of steam and calking wouldn't hold.

"Come on out and let it go!" Evans yelled into the fire-box.

"Damned if I do," Barton gritted. "Turn some cold water on me," he panted, as he hammered the calking chisel.

The spot held. The boilermaker picked up the electrode holder. When the arc was struck the seam opened again. The jet of steam played against the welding shield. A blister formed on an unprotected ear. Barton reeled as though he would fall.

He picked up the hammer and chisel again; desper-

ately the boilermaker hammered with all his waning strength. The spray of steam diminished, became just a wisp, then ceased. That time the weld held. The job was finished. Only a line of welding showed where the crack had been.

Barton stumbled to the fire door and collapsed with his head just outside. The fire builder and the boilermaker helper dragged Barton out of the fire-box. There was something suspiciously like tears in Evans' eyes as he looked at the blistered face of the boilermaker.

Barton wasn't out long. He soon revived in the fresh air of the cab. "Phew!" he sighed, "gimme a drink of water and a cigarette."

It's against rules to smoke on the job, but Evans lit the cigarette.

"That was a helluva hot job!" Barton remarked fifteen minutes later as he started back to the roundhouse to finish a job he had started there.

Shop Improvements at North Platte

The Union Pacific recently completed and now is using a new locomotive shop building at North Platte, Neb., one of its main-line points. In it has been installed the machinery formerly housed in a section of the roundhouse, together with some new units of equipment and a 20-ton traveling crane which has greatly increased the scope of work that can be handled at this point.

Exclusive of the existing machinery, the new building and new equipment represent an investment of about $225,000. The structure is 228 ft. long and 95 ft. wide and the shop building is 34 ft. high under the trusses. Along one entire side are the offices and other separate rooms, including tool room, electric shop, air room and locker, toilet and wash room facilities.

The building is of steel frame, covered with corrugated transite and insulated with 2 in. of rock wool. It is finished inside with Flexboard. The windows are all of heavy wired glass. Unit heaters and modern electric lighting fixtures are installed.

The new shop is connected directly with the roundhouse, so that locomotives can be run in for service over the two-track drop pit. Formerly shop machinery was housed in part of the roundhouse. Its removal releases 7 or 8 stalls for regular roundhouse running repairs.

The new equipment consists of a 36-in. shaper, a 24-in. roller-bearing-equipped precision engine lathe and a Micro internal rod grinder.

Included in the other machinery, which represents about $100,000, are four engine lathes of varying sizes, a driving-wheel lathe, a 600-ton hydraulic press, two 24-in. boring mills, a right line radio drill, a Columbia 32-in. shaper, a 30-in. by 30-in. by 12-ft. planer and a 36-in. punch and shear and other equipment necessary for the general shopping of locomotives.

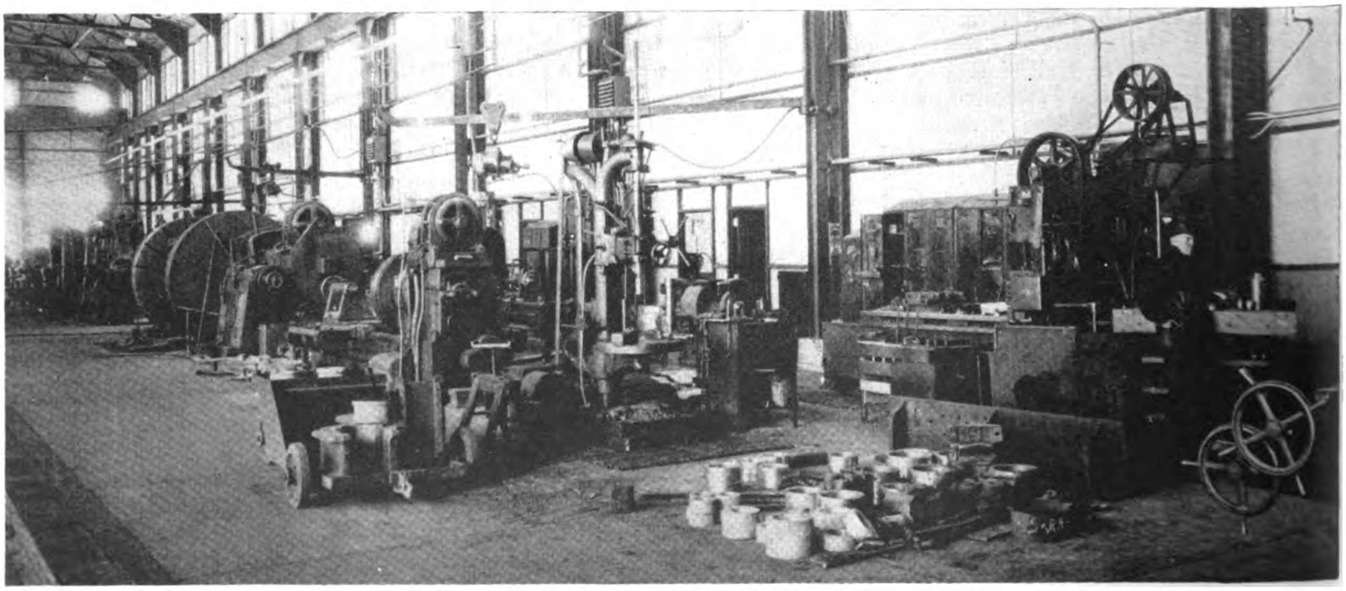
Lathe and Grinder Centers Tipped with Carboloy

Carboloy Company, Inc., Detroit, Mich., has developed a special application of Carboloy on lathe and grinder centers. These centers are the same as regular steel centers except that a Carboloy cone-shaped tip is substituted for the ordinary steel tips. Because of their diamond-like hardness, cemented carbides are suited to resist the extreme wear on these centers, particularly

Lathe center with Carboloy tip

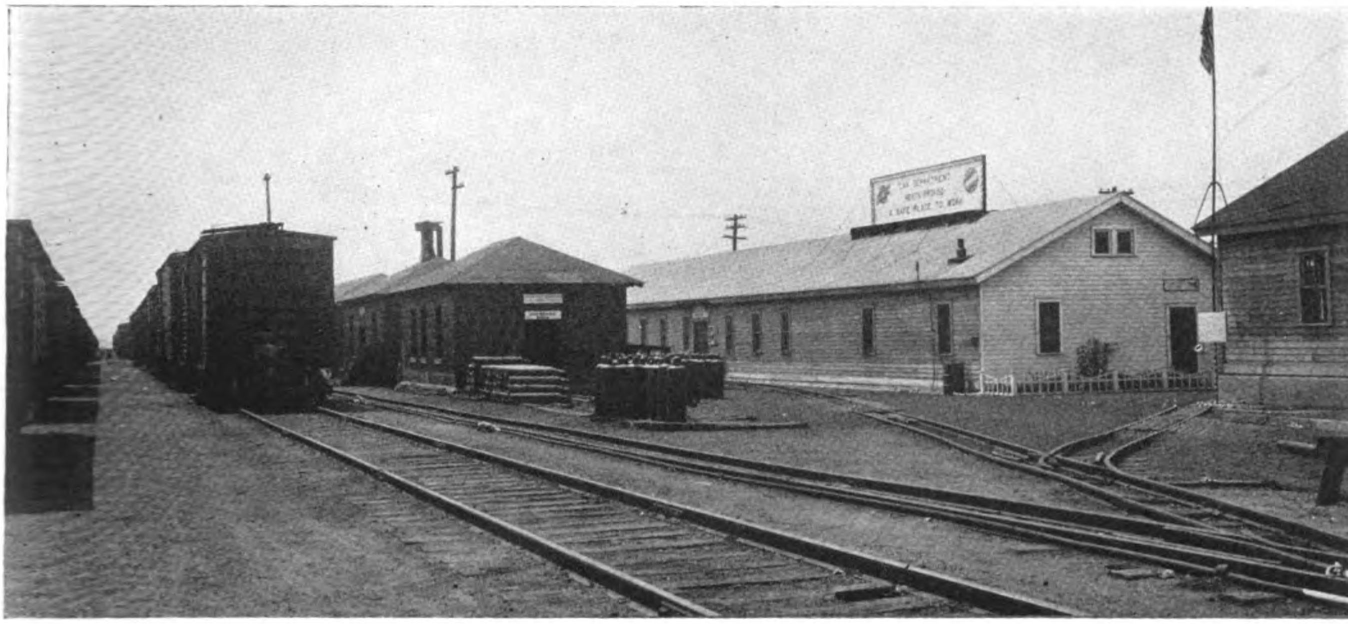
where the work is nitrided, case hardened, or heat-treated shafts. One report shows that in S.A.E.-2335 steel shafting, Carboloy centers stood up three years with one regrinding whereas ordinary centers lasted only one week. Reports to date shows that these centers wear 50 times longer than ordinary centers.

Besides its longer life, users report greater accuracy, elimination of burning and scoring, and fewer reconditionings. The centers are available in all sizes.



Machine-tool equipment in the new Union Pacific locomotive shop building at North Platte, Neb.

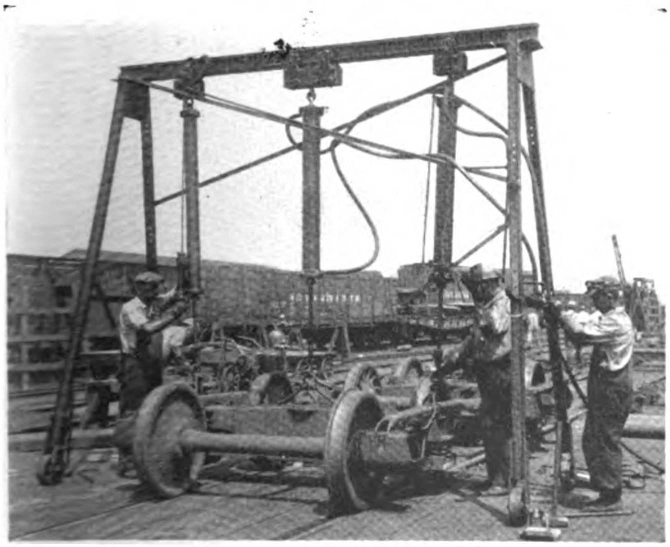
With the Car Foremen and Inspectors



General office building, storeroom and air brake room at C. & N. W. car repair yard, North Proviso, Ill.

Repairing Auto Cars At North Proviso

At the Chicago & North Western car repair yard, North Proviso, Ill., heavy repairs are now being given to a series of 998 automobile box cars, which were built new in 1928, subsequently equipped with Evans automobile loaders, and now being put over the repair tracks for new cast-steel side-frame trucks; dropping and repairing all draft gears; giving general repairs to the car superstructures, doors and roofs; applying new floors; loading devices inspected and repaired; air brakes repaired, cleaned and tested; cars repainted and stenciled. An output of at least 6 cars a day is secured with a force of 100 men, including the supervision, working 8 hours a day and 5 days a week.

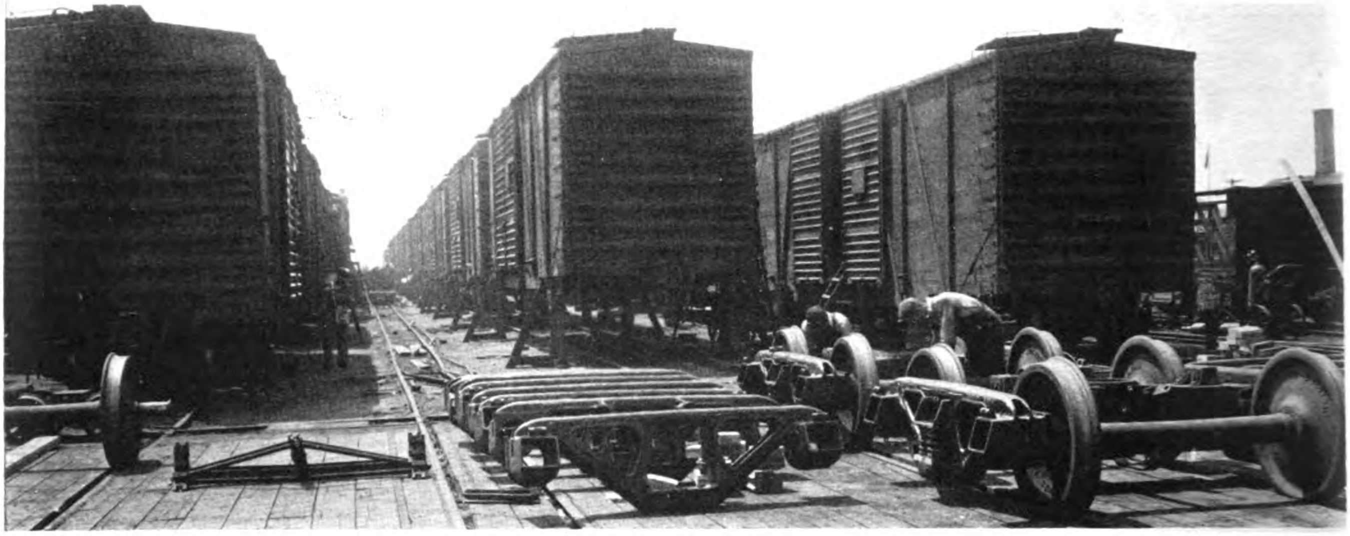


Portable truck-repair crane equipped with three pneumatic hoists

General Method of Operation

In common with other car-repair points on the C. & N. W., principal interest at North Proviso centers on safety and, with this objective in view, all materials, in so far as possible, are neatly stacked and the shops and grounds are kept clean and orderly, a fact well borne out in the illustration which shows the general office building, storehouse, air brake room, etc. This same illustration also shows quite clearly the narrow-gage rails which form part of the material-handling system provided for the easy handling of heavy materials from the storeroom and shops to all parts of the repair tracks with a minimum of manual labor. Numerous switches, run-around tracks and loading tracks are located as required and the mechanical equipment includes three gasoline engine-driven tractors and 50 narrow-gage trailers. One of these tractors with two car-wheel buggies ahead and a lumber trailer behind is shown in another of the illustrations.

The principal advantage of this narrow-gage track and equipment is that, for a comparatively small investment, reliable means of handling heavy materials is provided which involves minimum manual labor and may be depended upon to function regardless of adverse weather and roadway conditions, such as snow, ice, water-softened roadways, etc. Low power required, speedy delivery and the fact that the trailers can be easily moved a little by hand if necessary, after being spotted at a



The three tracks which are devoted to making heavy repairs of automobile box cars

car, are important additional advantages of the narrow-gage material-delivery system as demonstrated by experience on the C. & N. W. As compared with concrete highways and automotive-type equipment, the narrow-gage system also has the additional advantage that, with revised operating conditions and requirements, the tracks may be easily relocated or taken up if necessary.

One of the narrow-gage tractors mentioned is equipped with a boom and hoist which greatly facilitates loading heavy materials on the trailers. For still heavier material-handling operations throughout the yard, a Burro gasoline-engine-driven tractor, operating on standard-gage tracks and equipped with a 30-ft. boom and cable hoist, is used.

New Cast-Steel Truck Sides Applied

One of the principal jobs in connection with repairing the automobile box cars is the application of new cast-steel side frames to the trucks. The cars are switched to three of the shop tracks, as shown in one of the illustrations, there being twelve cars per track, evenly spaced between the track crossings. The first operation is to jack all of the cars on one track using a pair of air-operated jacks, one of which is shown in a separate illustration. The car bodies are set on substantial three-leg wooden horses, 5 ft. high, and all of the trucks are pushed out to the north end of the track, where they are inspected and rebuilt and then worked back under the cars in the reverse order.

The portable truck-repair crane, equipped with air hoists and used in making truck changes is shown in two of the illustrations. After all of the trucks on one track have been repaired and run back under their respective cars, the cars are jacked down and the car bodies on one of the adjacent tracks are jacked up. The trucks from the second group of 12 cars are moved out, the truck-repair crane placed over this track and the trucks overhauled and worked back under their respective cars as previously described. The same operation is then followed with cars on the third track.

Referring to the close-up view of the truck-repair crane the general construction will be evident. The top cross beam, 11 ft. high, is 12½ ft. long and made of a section of 90-lb. rail. The A-shape side frames are made of 3-in. I-beams, suitably braced and welded to the cross rail at the top and equipped with 10-in. wheels at the bottom, the width of the *A* frame at the base being 63 in. The frame is suitably stiffened by cross braces welded in place and three 5-in. by 52-in. air hoists are suspended from suitable roller-equipped blocks which may be easily moved along the top rail.

The advantage of this type of crane is its flexibility and the elimination of all manual labor in raising or lowering truck parts. After the old arch-bar trucks are cut apart and dismantled, the usable materials are sorted out and scrap materials segregated for subsequent loading with the Burro crane into a scrap car. The wheels and truck bolsters are brought under the crane where the bolsters are removed; the spring plank worked over and a new brake-beam suspension spring applied; wheels inspected for any defects and changed if necessary; new cast-steel side frames, brasses, wedges, etc., supplied. The provision of three hoists which may be used simultaneously greatly expedites this work and permits application of the heavy side frames with relatively little manual labor and much less chance of marring the journals. The truck then moves south to the next position where new brake-beam bottom rods and supports

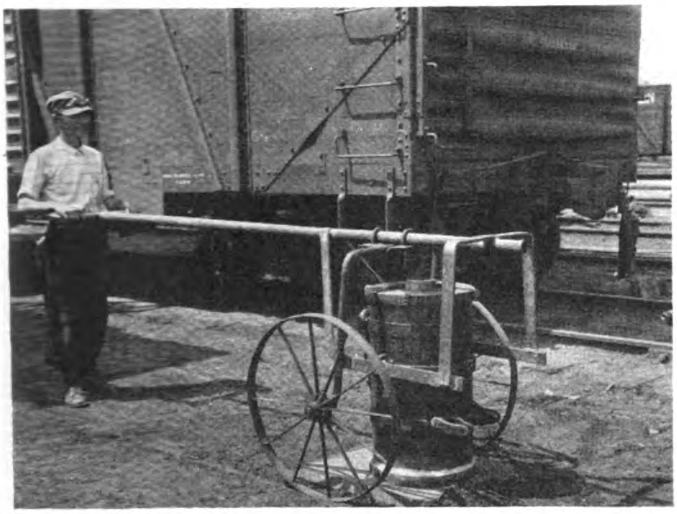
Safety step-ladder used in making repairs to door hangers and end platforms—Note slots provided for individual hand tools to prevent danger of dropping them

are applied, as are also the journal-box covers and dust-guard plugs.

Handling Cast-Steel Side Frames

In connection with the application of the cast-steel side frames, these somewhat heavy and awkward castings are handled to the truck repair position by means of a special two-wheel buggy, clearly shown in one of the illustrations. This buggy consists simply of a welded steel framework mounted on two 24-in. wheels and provided with a stationary hook to engage and support one end of the side frame while a sliding hook engages the other end. These two hooks are about equally distant from the wheel centers so that the side frame is in approximate balance and one man can easily move it wherever desired over smooth ground or a plank floor.

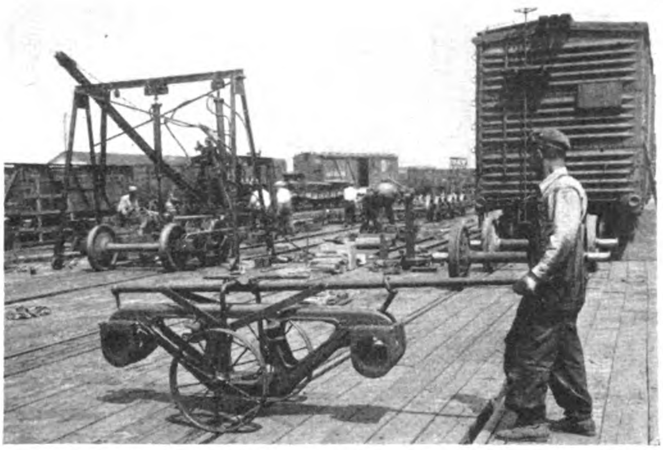
The upper bar of this buggy consists of a piece of 1½-in. pipe, 36 in. long from the hook end to the wheel support and 68 in. long from the wheel support to the short cross-bar handle used in moving the buggy. The



Light but strong two-wheel buggy used in moving the heavy air jacks

buggy frame is braced with strips of ½-in. by 2-in. steel welded to the top bar and to the wheel inverted U-frame, thus making the buggy both light and strong. This buggy, is similar in construction to the one shown in another illustration and used for moving air jacks.

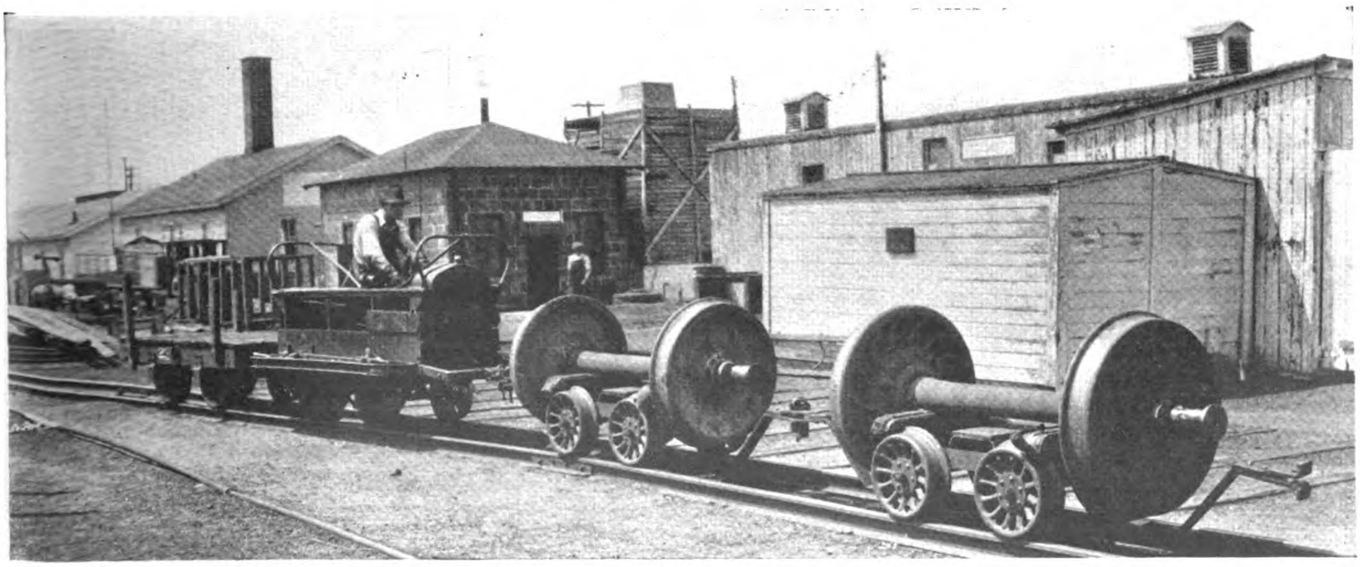
Still another device satisfactorily used at North Proviso in connection with the repair of these automobile cars is the safety step ladder shown in a separate illustration. This safety ladder, 12 ft. high overall, is made



Cast steel side frames are easily moved by one man using the two-wheel buggy

of 1¼-in. by 3½-in. wood side rails at the front and 1¼-in. by 2¼-in. side rails at the rear. The steps are ⅞ in. by 4¼ in. by 25 in. with the exception of the safety platform, 24 in. down from the top, which is 16 in. by 25 in. The step ladder is hinged at the top in the usual manner and equipped with reliable folding brackets to provide stiffness. A safety hand rail, made of ⅜-in. pipe, is applied to each side of the ladder. The top board is equipped with slots to receive such tools as hand saws, bit brace, hammer, wrench, etc. The ladder weighs 75 to 100 lb.

As shown in the illustration, this portable ladder provides a safe footing for car men when doing any work around the top of the car doors or end platforms which would otherwise be awkward to reach especially when loaded down with several small tools. In addition, the use of these tools on makeshift scaffolds presents a constant hazard due to the possibility of one or more of the tools accidentally dropping on a workman underneath.



Narrow-gage track and equipment used in moving car wheels from storage tracks to the truck repair position in the C. & N. W. car repair yards, North Proviso, Ill.

Rebuilt Milwaukee caboose in which the cupola has been replaced by side bay windows

Milwaukee Rebuilds Caboose Cars

The Chicago, Milwaukee, St. Paul & Pacific is now working on an extensive program of rebuilding and improving cabooses operated on this road and a total of 24 cars had been completed by April 1. Among important changes in construction is the removal of the familiar cupola and its replacement by a bay window on each side of the car; rearrangement of the entire interior to permit applying a standard reversible coach seat in each window; relocation of lockers, application of 1/4-in. 3-ply plywood ceiling for improved appearance and insulation; use of safety glass in end door and bay end windows; replacement of old stove by more efficient Pyropad stove; and replacement of the old oil lamp over the desk by a modified Acme oil lamp and special reflector which increases the number of foot-candles at desk level from 2 to 18.

The old swing motion trucks are being repaired and replaced. Both the interior and exterior of the car are sprayed with aluminum paint, which gives the car an unusually clean and neat appearance. The striking effect of this light metallic color is accentuated by black stencilling on the car sides, and the trucks, underframe, end platforms also are painted black. An air whistle is installed on each end of the car. Another feature, not generally used on cabooses, is the provision of a car journal brass and wedge locker which can be conveniently reached from the ground level outside the car. The advantages of this arrangement are self evident and the locker provides a safe place for the storage of car brass, as it is normally kept locked.

Advantages of the Bay Window Construction

The reason for replacing the cupolas with side bay windows is to permit the trainmen to sit in the caboose and inspect the train more easily as it is going along and note that there are no brake beams or truck parts dragging. Also they can readily detect hot journals. The presence of a hot journal often is detected by the odor arising from the burning of the oil-soaked waste used for lubricating the journal, and as these odors usually hang close to the ground, it is easier for the trainmen to detect them by opening the sliding window in the side of the bay occasionally than it would be if they were sitting in the cupola on top of the caboose.

There is also an added safety feature in that trainmen are not required to climb up and down to get in and out of the cupola. There have been accidents resulting from men having to climb up into the cupolas or when coming down out of them. Removal of the cupola has also permitted removal of the partitions in the car, resulting in a roomier, more airy, and more readily-heated caboose, as stated.

The improved type of stove installed has been tested

Interior of rebuilt Milwaukee caboose showing bay window construction, plywood ceiling and improved lighting table lamp installation

and found to be very efficient as well as economical. The top of the stove is arranged to permit trainmen to cook food and prepare coffee. Also a grill is provided which is a convenience when desiring to grill meats or toast bread. The stove is fully equipped with safety features, such as a provision to prevent the lids from becoming

displaced and doors opening, etc., in the event of an accident which might upset the stove.

The cabooses are provided with side seats 6 ft. long which are upholstered in leather, and are used by trainmen to make up beds during the time that they are at the terminal at the opposite end of their run. The standard coach seats in the side bays permit trainmen to assume a comfortable position when working at the desk, or watching the operation of the train.

Toilet facilities are also provided, as well as tool lockers and other conveniences such as washstand with water supply, and refrigerator in which to keep foodstuffs.

Special Attention to Lighting

A survey of lighting conditions in caboose cars with the usual type of oil lamp installations having indicated generally unsatisfactory conditions with a light intensity not in excess of 2 ft.-candles in certain instances, it was decided to effect a substantial improvement in the lighting of the rebuilt cabooses. By locating the single Acme lamp directly over the writing table, as shown in one of the illustrations and installing a special Benjamin 10-in. shallow type reflector, a marked improvement was secured. The lamp is mounted with the wick line 11 in. above the table and the reflector spaced with its edge 1⅜ in. above the wick line.

Using a Weston No. 703 foot-candle meter a series of measurements of light intensity at various points on the writing table were made. The table top is 30 in. wide by 39 in. long and the light intensity with this improved lamp installed varied from 6 ft.-candles at the table edges to 14, 18 and 20 ft.-candles as the meter was brought nearer to the center of the table. This may be compared with a light intensity of 10 to 12 ft.-candles which is all that is available in many of the older passenger coaches.

Questions and Answers On the AB Brake

Operation of the Equipment (Continued)

185—*Q.—What is the effect?* A.—Further flow of quick-action-chamber air to the atmosphere is cut off, and communication is re-established between the brake pipe and the quick-action chamber.

186—*Q.—By what means does a local emergency rate of reduction of brake-pipe air take place in the first stage of emergency?* A.—The vent valve in the emergency portion unseats, opening a large direct passage from the brake pipe to the atmosphere.

187—*Q.—What movement is the cause of the vent valve unseating?* A.—The emergency piston moves to the right, compressing its spring, allowing the graduating valve to move far enough on the slide valve to uncover a port connecting the quick-action-chamber to the chamber at the left of the vent-valve piston. The resultant movement of the vent-valve piston unseats the vent valve.

188—*Q.—During the initial movement of the emergency piston and graduating valve, does the opening from the quick-action-chamber to the atmosphere via the graduating valve and slide valve retard the movement of the emergency piston to the right?* A.—No.

189—*Q.—Why not?* A.—The quick-action-chamber air cannot reduce to atmosphere at the same rate as the brake-pipe pressure; therefore, sufficient differential is built up across the emergency piston to bring about the movement as described.

190—*Q.—What movement in the emergency portion does the rapid rate of reduction finally bring about?* A.—The emergency piston moves to the extreme right carrying the slide valve with it.

191—*Q.—How does the movement of the emergency slide valve effect communication between the quick action chamber and the vent valve piston chamber?* A.—The slide valve moves out of register with the one in the seat, but the slide valve movement uncovers port *H* in the seat, with the result that communication is open between the two chambers.

192—*Q.—How does this position affect the build-up of the brake cylinder?* A.—The emergency reservoir is connected by cavity *K* in the emergency slide valve through passages leading to the inshot valve. As the inshot valve is unseated at this time, pressure is free to flow past the valve to a passage leading to the brake cylinder connection.

193—*Q.—How is the service portion affected by the emergency rate of reduction?* A.—The service piston and the slide valve move to the extreme left, permitting auxiliary reservoir pressure to flow past the service graduating valve, through the service slide valve and seat to the passage leading to the inshot valve.

194—*Q.—Does this flow of air unite with the flow from the emergency reservoir?* A.—Yes. The auxiliary and the emergency reservoir air combine, flowing past the unseated inshot valve to the brake cylinder passage.

195—*Q.—Is there any pressure in the inshot piston volume, or on the spring side of the inshot piston at this time?* A.—No. The emergency slide valve has blanked this port connection in its seat.

196—*Q.—How does this affect the position of the inshot valve?* A.—The inshot piston spring holds the valve open, permitting an unrestricted flow to the brake cylinder.

197—*Q.—What is the maximum brake cylinder pressure obtainable in the first stage emergency?* A.—15 lb.

198—*Q.—What movement limits the amount of pressure?* A.—The force of the inshot piston spring is overcome when 15 lb. brake cylinder pressure is developed and the piston moves to the left, permitting the inshot valve spring to close the valve.

199—*Q.—What is the approximate time required to obtain 15 lb. brake cylinder pressure in the first stage of emergency?* A.—1¼ sec.

200—*Q.—What change in the rate of the brake cylinder build-up occurs in the second stage emergency?* A.—As the inshot valve is now closed, a delayed build-up is now ensuing through the delay choke only.

201—*Q.—For approximately how many seconds does the delayed build-up continue?* A.—5¼ sec.

202—*Q.—How much brake cylinder pressure is developed during the second stage emergency?* A.—The pressure builds up from the 15 lb. obtained in the first stage to approximately 43 lb.

203—*Q.—What movement terminates the duration of the second stage emergency or delayed build-up?* A.—The unseating of the timing valve. This is also the beginning of the third or final stage.

204—*Q.—Explain the unseating of the timing valve.* A.—The quick-action-chamber pressure is on the left of the timing valve, while the brake cylinder air is on the right. Brake cylinder pressure has been increasing while quick-action chamber-air is being reduced to the atmosphere. When this pressure has been reduced to a certain relation to the brake cylinder pressure, the timing valve unseats.

205—*Q.—In what way does this change the rate of the flow to the brake cylinder?* A.—The unseating of the timing valve permits the air to flow to the brake

cylinder through the timing valve choke in addition to that supplied through the delay choke.

206—*Q.—Approximately what time is involved in the third stage of final build-up?* A.—2½ sec.

207—*Q.—What pressure is finally developed in the brake cylinder?* A.—60 lb.

208.—*Q.—In summing up the three stage operation, what does it provide?* A.—An initial inshot of the pressure from the combined auxiliary and emergency reservoirs to the brake cylinder of a limited amount but at an unrestricted rate, followed by a delayed build-up, and finally a fast rate to equalization.

209—*Q.—When is this controlled brake cylinder pressure development modified?* A.—When a partial service brake application precedes an emergency.

210—*Q.—When is it completely annulled?* A.—When the brake application has in service 30 lb. or more brake cylinder pressure previous to the emergency application.

211—*Q.—What does the amount of the inshot pressure and the delay time before the final build-up depend upon?* A.—It depends on the amount of brake cylinder pressure in the inshot piston volume and on the left of the inshot piston at the time the emergency takes place.

212—*Q.—Why is a higher brake cylinder pressure obtainable during emergency than in a full-service application?* A.—Because both the auxiliary and the emergency reservoirs equalize into the brake cylinder.

Decisions of Arbitration Cases

(The Arbitration Committee of the A.A.R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Re-Light-Weighing Car Within Date

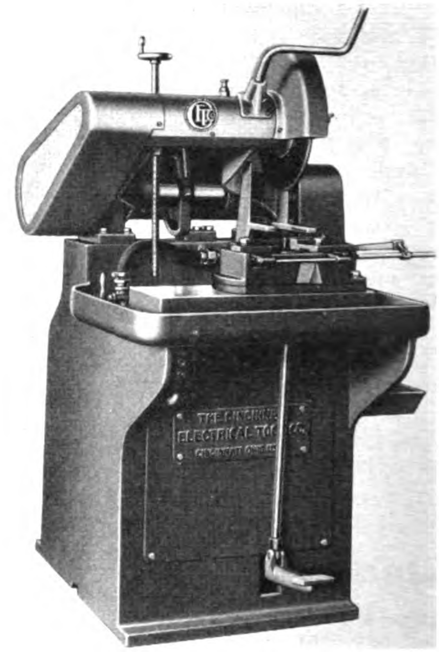
The Seaboard Air Line reweighed and restenciled the Central Vermont car 41099 at Hermitage, Va., July 5, 1934, the previous weighing date on which was July, 1932, and rendered a charge amounting to $16.59. The car owner took exception to the charge, claiming that old weight was not out of date, citing paragraph (B), A.A.R. Rule 30, and Interpretation No. 4 thereto.

The Seaboard Air Line agreed that the car was reweighed in the 24th month instead of after the expiration of 24 months, and that technically the car was not due for reweighing. However, it quoted a previous case involving a S.A.L. car on which air brakes had been cleaned by another road on the last day of the 12-month period and not after the expiration of 12 months. In this case the Arbitration Committee supported the contention that the car was not due for cleaning but suggested that the car owner accept the charge because of the nearness of the expiration of the 12-month period and because no complaint had been made as to the character of the work. The car owner protested this suggestion but was made to accept the charge. The S.A.L. contended that since the reweighing of the Central Vermont car was done in the 24th month and that the cleaning of the brakes on the car in the quoted case was done on the last day of the 12-month period, and since reweighing is figured on a monthly basis and brake cleaning is figured on a daily basis, the two cases are exactly alike in principle.

In a decision rendered Nov. 14, 1935, the Arbitration Committee said, "Interpretation No. 4 to Rule 30 applies. The contention of the Seaboard Air Lines is not sustained."—*Case No. 1748, Central Vermont versus Seaboard Air Line.*

Wet Abrasive Cut-Off Machine

The Cincinnati Electrical Tool Company, Cincinnati, Ohio, has announced a wet abrasive cut-off machine suitable for straight or angle cutting of practically any material, including steel alloys, non-ferrous metals such as brass, copper, aluminum, as well as fibrous and plastic materials in various sizes, angles and shapes. The wet-



Cincinnati wet abrasive cut-off machine for steel, non-ferrous metals, and fibrous and plastic materials

cutting feature was developed not only to increase the life of the abrasive cut-off wheels, but also to produce a cut with a minimum of burr and to eliminate burning. The coolant is directed not only on the point of contact of the cut, but on the sides of the wheel as well.

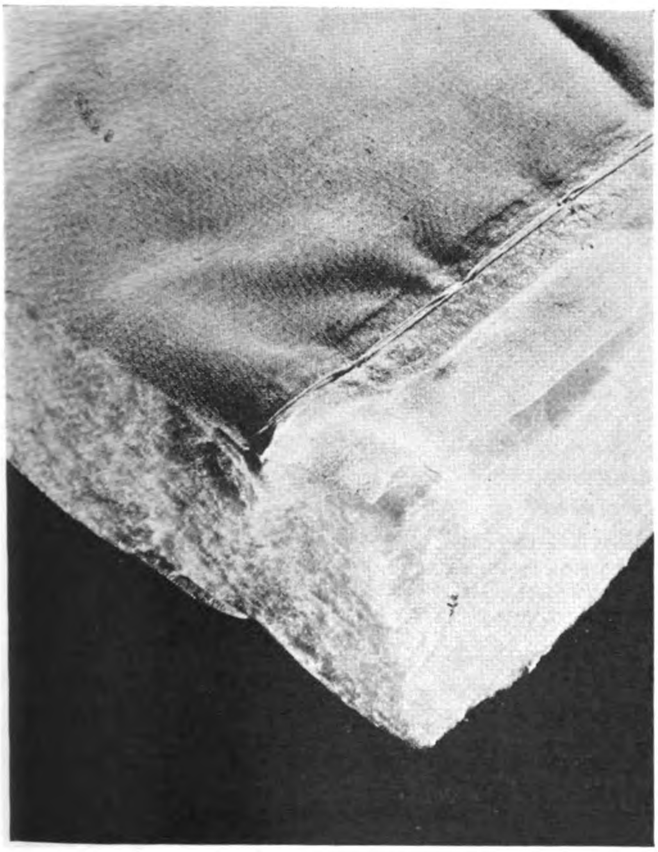
The machine is suitable for making straight or angle cuts in solids up to 2¼ in. or tubing up to 3½ in. diameter, the same vise being suitable for the various cuts. In cutting angles up to 45 deg., however, the maximum capacity is 2¼ in. Graduations on the table facilitate angle-cutting. A stop is provided which can be set for any depth of cut within the machine's capacity, and a longitudinal stop is provided for regulating the length of the material to be cut.

The material is held in the vise by spring tension on the jaws and the work is released by the foot lever after the cut is completed, leaving the operator's hands free at all times. The work is held on both sides of the cut, eliminating the possible cramping of work and preventing wheel breakage. The abrasive wheel is moved into the work by means of a hand lever; the arm which carries the abrasive wheel pivots on the pedestal with a counterbalance to facilitate operation. The abrasive cut-off wheel is completely guarded, with exception of that portion necessary for the actual cutting operation.

Two sets of wheel flanges, in different sizes, are furnished to ensure the maximum use of the abrasive wheels. A shaft locking device facilitates changing of wheels. The coolant system consists of a 1/4-hp. motor-driven centrifugal pump with 10-gal. tank, piping and control drive. The spindle is of nickel-steel, mounted on sealed-type deep-groove ball bearings running in oil. Labyrinth seals are used to prevent the ingress of grit or dirt into the bearing housings. The spindle is driven by multiple V-belts from a 7½-hp. ball-bearing drip-proof motor running at 1,800 r.p.m., mounted in the pedestal with magnetic starter with overload and no voltage protection and push-button control. The machine can also be furnished with a 10- or 15-hp. motor if desired.

Fibrous Glass Insulation For Railway Equipment

Two types of insulating blankets of fibrous glass, one type for refrigerator cars and passenger cars, and another for locomotives, have just been placed upon the market by the Armstrong Cork Products Company, Lancaster, Pa. Both of these use as its basic material



Armstrong-Corning fibrous-glass wool insulation for refrigerator and passenger cars and locomotives

the Armstrong-Corning wool insulation made by the Corning Glass Works, Corning, N. Y., and sold by Armstrong. The insulating blankets for refrigerator and passenger cars are available in thicknesses from ¾ in. to 5 in., and in sizes up to 9 ft. by 50 ft., or longer if required. They may be had faced on one or both sides with Sisalkraft, muslin, flame-proof muslin, or any specified material. In addition to the blankets, this insulation is available in plain bats, rolls and other usable forms.

For locomotive insulation, metal-mesh blankets of Armstrong-Corning wool insulation are available in thicknesses from 1 in. to 6 in. These insulating blankets are stitched with asbestos twine to metal fabrics, such as metal lath, hexagonal-mesh woven wire, or fly screen applied to one or both sides of the blanket as required. This insulation is said to be effective for temperatures up to 900 deg. F. and weighs approximately one-fifth as much as materials now being used.

Lightweight Lantern For Inspectors

A lightweight carbide lantern weighing approximately 6 lb., and equipped with a safety flame protector, heat-resisting glass lens and porcelain burner tips has recently been made available by the National Carbide Corporation, New York. It was designed primarily to

The National Carbide NJ-1 inspector's lantern equipped with a safety flame protector, heat-resisting glass lens and insulated handle

meet the requirements of car inspectors and has the following features: It can be used for eight hours on one charge of carbide, and it has an insulated handle to protect the workman against third rails and any exposed electric equipment, a positive water-feed control and a patented rear light of any desired color specified by the purchaser.

To insure long service and prevent corrosion, brass has been used in fabricating the water-carbide chambers. A novel and convenient feature of the lantern is the treatment of the threads joining the upper part of the lantern with the carbide chamber. In order to prevent damage when shaking out the contents of the carbide chamber, the usual arrangement has been reversed and the inside threads placed inside the chamber and outside threads on the upper part of the lantern.

Among the Clubs and Associations

Oil and Gas Power Meeting

The Oil and Gas Power Division of the American Society of Mechanical Engineers will hold its tenth annual national meeting at State College, Pa., August 18 to 21. The program includes several items of interest to railroad men. Among these are the following:

Wednesday, August 18
2 p. m.
General Session

Progress Reports by American Locomotive Company, Atlas Imperial Diesel Engine Company, The Buda Company, Caterpillar Tractor Company, Davenport Besler Corporation, DeLaVergne Engine Company, General Motors Corporation, Ingersoll-Rand Company, Nordberg Manufacturing Company, and others.

U. S. Navy Contributions to Diesel Engine Development, by E. C. Magdeburger, Bureau of Engineering, U. S. Navy Department.

Thursday, August 19
9:30 a. m.
Fuels and Lubrication Session

Lubrication Problems in Connection with High-Speed Diesel Engines, by C. G. A. Rosen, Caterpillar Tractor Company.

Correlation of Laboratory Tests on Fuel Oils with Field Operation, by W. F. Joachim, U. S. Naval Experiment Station.

2 p. m.
Transportation Session

Recent Developments in Automotive Type Diesel Engines, by O. D. Treiber, Hercules Motors Corporation.

Friday, August 20
9:30 a. m.
Operating Session

1936 Oil Engine Power Cost Report, by H. C. Major, chairman, Oil Engine Power Cost Sub-Committee.

Waste Heat Recovery from Diesel Engines, by Glenn C. Boyer, Burns & McDonnell Engineering Company.

Penn State Method of Testing Diesel Fuels, by J. S. Chandler, Pennsylvania State College.

Saturday, August 21
9:30 a. m.
Research Session

Oil Flow Through Fuel Nozzles, by Prof. K. J. DeJuhasz, Penn State College.

Polymerization of Fuel Oils, by Gustav Egloff, Universal Oil Products Company.

There will be an exhibit of Diesel engine parts and accessories held in connection with this meeting.

Eastern Car Foremen's Outing

The Eastern Car Foremen's Association held its annual outing, known as New Haven Day, at the Race Brook Country Club, New Haven, on July 15. Approximately 220 railroad and supply men attended. The program was of a varied nature and provided a number of competitive events. The winners of the principal ones were as follows: In the golf tournament L. H. Foster, of the Chicago Railway Equipment Company, took the prize for the low net score, while the low gross prize went to Ray P. Townsend of Johns-Manville Sales Corporation. The low net prize in Class B went to J. F. Daley of the New Haven, and the low gross prize went to A. Bixby, of Sponge Rubber Products Company. The low net prize in Class C went to W. F. Clarke, New Haven, and the low gross prize was taken by K. Cartwright, New York, New Haven & Hartford. Harry Nunn, of the Boston & Albany, took the prize for the longest drive. In the putting contest for golfers, first prize was taken by C. C. Hubbell of the Delaware, Lackawanna & Western, and second prize by P. D. Malloy, of Gustin-Bacon Manufacturing Company. There was also a putting contest for non-golfers, in which first prize was taken by Charles Hillers, L. C. Chase & Company, and second prize by L. J. McClain, Delaware & Hudson. The first and second prizes in the quoits contest were taken by Carl Dierks and Arthur Bibb, both of the Delaware & Hudson.

American Welding Society To Meet in October

The eighteenth annual meeting and welding exposition of the American Welding Society will be held at Atlantic City, N. J., on October 18-22, the meeting at the Hotel Traymore and the exposition at Convention Hall. Technical sessions on industrial research and fundamental research in welding, a joint session with the American Society of Mechanical Engineers, a Symposium on Alloy Steels and a Railroad Session are among the features scheduled on the tentative program which is, in part, as follows:

Monday, October 18
2 p. m.
Industrial Research

Weldability of Low Alloy Steels, by W. L. Warner, Watertown Arsenal.

Survey of Low-Alloy Steels as to Weldability, by J. H. Critchet, Union Carbide & Carbon Research Laboratories.

The Problem of Correlation of Radiographs and Mechanical Tests of Welds, by J. T. Norton, Massachusetts Institute of Technology.

Tuesday, October 19
9:30 a. m.

A Study of Stress Relief in Metals by an X-Ray Method, by J. T. Norton, Massachusetts Institute of Technology.

2 p. m.

Static and Impact Tensile Properties of Stainless Steel Welds at Ordinary and Low Temperatures, by O. H. Henry, Polytechnic Institute of Brooklyn.

Joint Session with American Society of Mechanical Engineers

Resistance Welding Fabrication, by J. M. Cooper, General Electric Company.

Fusion Welded Fabrication, by H. N. Blackmon, Westinghouse Electric & Mfg. Co.

Thursday, October 21
9:30 a. m.
Symposium on Alloy Steels

Low Alloy Steels, by G. S. Mikhalapov, Heintz Manufacturing Company.

Friday, October 22
9:30 a. m.
Railroad Session

Building Up Locomotive Drive Box, by I. T. Bennett, Revere Copper & Brass, Inc.

Machine Gas Cutting in Railroad Work, by H. Bass, New York Central.

Welding of Railroad Rolling Stock, by V. R. Willoughby, American Car and Foundry Company.

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Delaware & Hudson car-foreman's twelfth annual outing held at Saratoga Lake, N. Y., July 17. This outing is sponsored by the D. & H. and serves jointly for discussion of car-department problems and recreation of car-department officers, their families and guests. A total of approximately 250 persons attended this year's outing

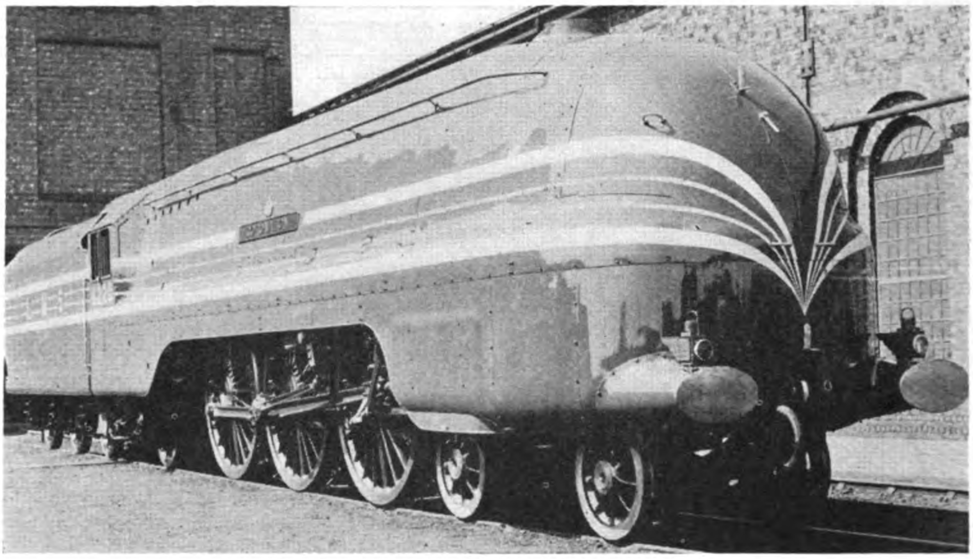
Again STEAM!

For hauling their heavy fast passenger trains the Boston and Maine Railroad recently received from Lima five modern 4-6-2 type locomotives.

This new power combines high sustained tractive effort, rapid acceleration to road speeds and low cost operation.

In any service, today's high standard of train operation can be maintained and at the lowest possible cost only by utilization of modern steam power.

LIMA LOCOMOTIVE WORKS, **LIMA LOCOMOTIVE WORKS INCORPORATED** INCORPORATED, LIMA, OHIO



The "Coronation Scot," the first streamline locomotive of the London, Midland & Scottish Railway, for service between London and Glasgow

NEWS

New Construction

THE Northern Pacific has awarded a contract to the Standard Construction Company, Tacoma, Wash., for the construction of a one-story addition to its enginehouse and shops at Pasco, Wash., at a cost of about $40,000.

Air Brake Meeting Correction

IN the report of the concluding session of the Air Brake Association meeting, which was held at Atlantic City, the *Daily Railway Age* in its issue of June 21, page 1040D16, made the statement that the paper on the Type AB Empty and Load Brake Equipment, presented by the Pittsburgh Air Brake Club, was read by George Cotter, Westinghouse Air Brake Company. This paper, which was presented by the Pittsburgh Air Brake Club, was read by E. F. Richardson, assistant engineer of motive power, Bessemer & Lake Erie Railroad, and not by Mr. Cotter.

Pennsylvania Harrisburg Improvements to Cost $2,000,000

THE Pennsylvania, in connection with the extension of its electrified territory for both passenger and freight service westward from Paoli, Pa., to Harrisburg, has started work, at a cost of about $2,000,000, on the construction in Harrisburg of a new passenger engine terminal, a locomotive coaling station and a number of associated facilities. In connection with the building of the new facilities considerable track rearrangement will also be necessary.

The new enginehouse will be located just west of Harrisburg station, between Herr and McClay streets on the east side of the main line passenger tracks, and will be one of the largest on the Pennsylvania system. It will be built of brick and will contain 30 stalls, 18 of which will be 140 ft. in length and 12 of 120 ft. in length. A turntable in the center, 125 ft. long, will be the largest so far installed by the Pennsylvania. Included in the terminal facilities will be ash and inspection pits, an oil house and storehouse, a completely equipped machine shop, 80 ft. by 180 ft., and a welfare building for the enginehouse and train service employees.

It is planned to have the entire project completed by the close of the present year.

(Turn to next left-hand page)

New Equipment Orders and Inquiries Announced Since the Closing of the July Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
C. M. St. P. & P.	1	4-8-4 oil-burn.	Company shops
Newburgh & South Shore	2	0-6-0	Lima Loco. Works
Newfoundland Ry.	1	2-8-2	North-British Loco. Co.
Phelps Dodge Co.	6	50-ton flat	Youngstown Steel Car Corp.
Roberval & Saguenay	1*	2-8-0	Canadian Loco. Co.

Locomotive Inquiries

E. J. & E.	7	Diesel-elec. switch.	....

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Cabot, Godfrey L., Inc.	20†	Covered hopper	American Car & Fdry. Co.
Canadian National	30	Sand	National Steel Car Corp.
Chicago & North Western	50	Caboose underframes	American Car & Fdry. Co.
C. M. St. P. & P.	1,000	70-ton gondola	Company shops
Hercules Powder Co.	4	6,000-gal. tank	Gen. Amer. Trans. Corp.

Freight-Car Inquiries

Cambria & Indiana	500	50-ton hopper	....
Illinois Central	500	Hopper	....
Peoria & Pekin Union	25	Hopper	....
Texas & Pacific	500 or 1,000	Steel sheathed box	....
	100	50-ton hopper	....
U. S. Navy Dept., Bureau of Supplies and Accounts	2	70-ton flat	....
Utah Copper Co.	3	30-ton caboose	....

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
New York Central	6‡	Diners	Pullman-Std. Car Mfg. Co.
	4‡	Bagg. and mail	Pullman-Std. Car Mfg. Co.
Southern Pacific	2	Tavern	Pullman-Std. Car Mfg. Co.
	2	Coffee-shop	Pullman-Std. Car Mfg. Co.

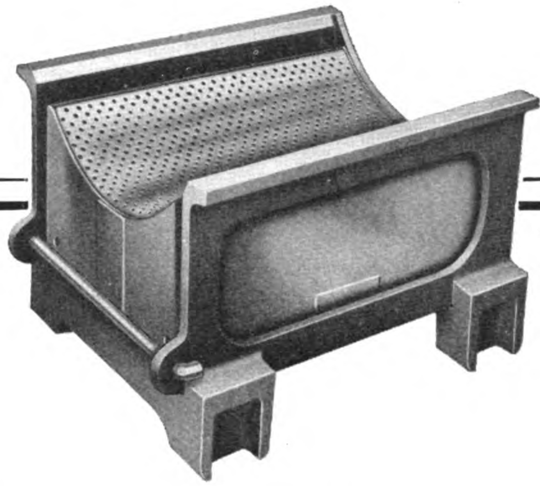
* This locomotive, which has now been delivered, has a weight on drivers of 206,000 lb. and a maximum tractive power of 47,300 lb. The tender is of the eight-wheel type with a capacity for 7,000 imperial gallons of water and 14 tons of coal.

† These cars are to have a maximum capacity of 40 tons and are intended to carry approximately 32½ tons of granular carbon black. There are three compartments in each car with separate hopper outlets, and the cars are completely self-clearing by gravity.

‡ To be of light-weight alloy steel.

LUBRICATION

is a Major Problem



When the Franklin Automatic Driving Box Lubricator was first introduced, driving axle lubrication difficulties vanished.

Modifications in lubricator design suited to advances in locomotive design have been made, but the fundamental principle of grease reaching the axle through a perforated plate remains unchanged.

Assurance of proper lubrication can be had only when this perforated plate is properly designed and properly made.

These perforated plates, made for Franklin Driving Box Lubricators by the Franklin Railway Supply Company, Inc., are your assurance of properly lubricated, trouble-free driving journals.

When the cost of lubricator plates for a year's service on a locomotive is matched against the cost of one detention due to faulty lubrication the cost of Franklin lubricator plates becomes insignificant.

REG. U.S. PAT. OFF.

When maintenance is required, a replacement part assumes importance equal to that of the device itself and should be purchased with equal care. Use only genuine Franklin repair parts in Franklin equipment.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

To Conduct Research on Air-Conditioning Filters

THE Association of American Railroads, through the Division of Equipment Research, will conduct, this summer, a research of air-conditioning filters now in use on the railroads of the United States and Canada. The tests will be made in the engineering experimental laboratories of the University of Minnesota in accordance with the code adopted by the American Society of Heating and Ventilating Engineers. In addition to the laboratory tests, road tests will be made under actual operating conditions. The results of both road and laboratory tests will then be correlated.

It is felt that the dust specified by the code for testing purposes does not simulate the type of dust encountered in railroad service. In order, therefore, to develop a dust for testing purposes which is comparable to that actually encountered, samples are being obtained for analyzing purposes. The results of this research will be made available to the railroads before the next air-conditioning season.

"Rocket" Makes Maiden Trip

THREE light-weight, stainless steel cars constructed for the Chicago, Rock Island & Pacific for one of its "Rockets" made their first trip on July 12 when they carried a delegation of Chicago members of the Elks fraternity to the national convention at Denver, Colo. These cars, constructed for the train to operate between Kansas City and Denver, were hauled by an 1,800 hp. Diesel-electric locomotive and made the trip in 16 hr. 35 min., leaving Chicago at 7 a. m. and arriving in Denver at 11:35 p. m.

I. C. C. Ratifies Lyford Appointment

THE appointment of Frederick E. Lyford as sole trustee of the New York, Ontario & Western has been ratified by

Frederick E. Lyford

the Interstate Commerce Commission, which, at the same time, has denied the similar application of Vincent Dailey, who had been nominated by the court for the position of co-trustee with Mr. Lyford.

Mr. Lyford had been associated with the Lehigh Valley in mechanical and special engineering capacities for ten years prior to 1934, when he became an examiner with the Railroad division of the Reconstruction Finance Corporation; since September, 1936, he has been assistant to the vice-president and director of sales of the Baldwin Locomotive Works.

Equipment Depreciation Orders

THE Interstate Commerce Commission has issued another series of sub-orders in No. 15100, Depreciation Charges of Steam Railroad Companies, prescribing equipment depreciation rates for the Detroit & Mackinac and five other small roads—the Milstead, the Mobile & Gulf, the Aberdeen & Rockfish, the Alabama Central, and the Carolina Southern. The composite percentages, which are not prescribed rates, range from 2.9 per cent for the Detroit & Mackinac to 13.61 per cent for the Alabama Central. The latter figure, however, is the rate prescribed for steam locomotives, since the road owns no other rolling stock. Prescribed rates for the Detroit & Mackinac are: Steam locomotives, 2.35 per cent; other locomotives, 9.75 per cent; freight-train cars, 2.58 per cent; passenger-train cars, 3.49 per cent; work equipment, 3.03 per cent; miscellaneous equipment, 18.48 per cent.

Supply Trade Notes

G. O. HAUSKINS, sales representative of the Peerless Equipment Company, with headquarters at New York, has been transferred to Chicago.

J. E. VAUGHN, assistant to the vice-president, of the Standard Railway Equipment Company and its associate, the Union Metal Products Company, has been transferred from the Chicago office to the New York office.

D. W. LAMOREAUX, whose appointment as vice-president of the Peerless Equipment Company, Chicago, was announced in the July issue of the *Railway Mechanical Engineer*, has now been elected president to succeed A. A. Helwig, resigned.

CLARENCE D. HICKS, president of the R & C Company, St. Louis, Mo., has also been elected vice-president of the Union Railway Equipment Company, in charge of sales in the southern and southwestern districts.

D. P. MORGAN, who recently resigned as railroad representative of the Garlock Packing Company at Philadelphia, Pa., has become southeastern manager of the Okadee Company and its associate company, the Viloco Railway Equipment Company, with headquarters in Atlanta, Ga.

G. F. AHLBRANDT and W. W. Lewis have been appointed as assistant vice-presidents of The American Rolling Mill Company, and H. M. Richards has been appointed manager of the sheet and strip sales division.

THE DEVILBISS COMPANY, Toledo, Ohio, will hold training school classes, for painters and refinishers interested in learning the technique of spray painting and the use and care of spray-painting equipment, for periods of one week beginning August 23, September 27, October 25, November 15 and December 13.

W. H. BLACKMER has resigned as sales manager of the Laminated Shim Co., Inc., Long Island City, N. Y., to become vice-president and general manager of the Packless Metal Products Corporation, Long Island City, manufacturers of seamless flexible metal hose, packless fittings and other metal products.

MARSHALL M. COOLEDGE has been appointed sales representative of The Buckeye Steel Castings Company, with office at 50 Church street, New York. Mr. Cooledge is a graduate engineer, class of 1926, of the University of Illinois. He was connected with the Timken Roller Bearing Company in sales and engineering on the Pacific Coast, and later with the Joseph T. Ryerson & Son, Inc., in the St. Louis district, before joining the Buckeye organization.

H. M. ARRICK, who for the last 10 years has been associated with the American Rolling Mill Company, Middletown, Ohio, in various railroad sales capacities, has been appointed manager of the newly created district office of the Armco Railroad Sales Company. Mr. Arrick's headquarters will be in the Ambassador building, St. Louis, Mo.

THE STANDARD RAILWAY EQUIPMENT COMPANY and its associate, the Union Metal Products Company, have opened an office in the Terminal Tower, Cleveland, Ohio, in charge of J. H. Schroeder, who is assistant to the vice-president. Mr. Schroeder had been previously in charge of the St. Louis office of the above companies.

F. C. RITNER of the Carboloy Company, Incorporated, Detroit, Mich., has been appointed assistant to the president, in charge of special wear-resistant applications, new developments and special products. T. D. MacLafferty, formerly of the Detroit district office of the General Electric Com-

(*Continued on next left-hand page*)

pany, has been appointed assistant to the general sales manager, and H. C. Stone, formerly of the Newark office, now represents the Carboloy Company in Brooklyn, N. Y., and New York City territory.

THE Consolidated Ashcroft Hancock Company, Inc., has been dissolved and absorbed by the parent corporation, Manning, Maxwell & Moore, Inc., New York. The Railway Sales Division of the Consolidated Ashcroft Hancock Company, Inc., has also begun operation as the Locomotive Equipment Division of Manning, Maxwell & Moore, Inc. This change affects only the operating details of the corporation. Manning, Maxwell & Moore, Inc., has always been the sole owner of the Consolidated Ashcroft Hancock Company, Inc.

J. L. TERRY, president of the Q & C Co., has been elected also treasurer; M. Iseldyke, Jr., secretary since 1924, has been appointed vice-president; R. R. Martin, who has been with the company since 1915, having served in the capacity of auditor and assistant treasurer since 1924, has been elected secretary and assistant treasurer; all with headquarters at New York City. Lewis Thomas, district sales manager at Chicago, has been promoted to general sales manager with headquarters at Chicago. Prior to graduating from Lehigh University, Mr. Thomas was employed in maintenance and construction

(c) *Moffett*

Lewis Thomas

work on the Pennsylvania at Newcastle, Pa. Later, he was employed by Alexander Potter, consulting engineer at New York, to assist in the construction of water filtration plants. Later he was connected with the Crescent Portland Cement Company during the construction of its plant and by the Pennsylvania Engineering Works as resident engineer on the construction of a Bessemer plant and trackage at Bethlehem, Pa. From 1911 to 1914 he was engaged in contracting work at Minneapolis and from 1914 to 1918 served as senior civil engineer for the Interstate Commerce Commission. In the latter year he became a sales representative of the Dravo-Doyle Company, Pittsburgh, Pa., and in 1920 resigned to become sales representative of the Q & C Company at Chicago. In 1928 he was appointed district sales manager.

Obituary

WALTER CARY, vice-president of the Westinghouse Electric & Manufacturing Co., died suddenly on July 2, from a heart attack at his home in New York City.

GEORGE P. DIRTH, southwestern manager of the Okadee Company and the Viloco Railway Company, with headquarters at St. Louis, Mo., died suddenly at Springfield, Ill., on July 8.

WILLIAM C. STETTINIUS, a director of the Worthington Pump and Machinery Corporation and other organizations, died in Baltimore, Md., at the age of 41.

FITZ WILLIAM SARGENT, chief engineer of the American Brake Shoe & Foundry Company, died on July 25 at his home in Mahwah, N. J., after a long illness, at the age of seventy-eight. Mr. Sargent was born at Philadelphia, Pa., January 4, 1859, and immediately after graduating from Lehigh University, with a degree of Civil Engineer in the class of 1879, became connected with the Rio Grande Construction Company and was in charge of a group of surveyors on location in connection with the locating and building of the Denver & Rio Grande. Following this, Mr. Sargent joined an engineering party and assisted in locating parts of the Mexican National Railway. Later, as resident engineer with the Norfolk & Western, he assisted in locating some of the track for that railroad. He continued in civil engineering work on railroads until 1884, at which time he went to the Chicago, Burlington & Quincy, with which company he remained until 1891, first as engineer of tests until 1886 and then as mechanical engineer. While with the Burlington Mr. Sargent participated in the now famous Burlington Brake Trials which determined the type of freight brake equipment since used on the railroads in this country. It was the experience on these brake trials which first interested him in braking problems and lead him into the field of brake-shoe engineering. As one of the first steps in brake-shoe engineering, Mr. Sargent, in 1889, built a small brake-shoe testing machine in the laboratory of the Burlington at Aurora, Ill. This machine tested miniature brake shoes 4 in. long by 1 in. wide on an 11½-in. diameter chilled-iron wheels. Tests made on this small machine furnished information relative to brake-shoe characteristics which proved to be of great value in establishing braking practice. Later Mr. Sargent co-operated with the Master Car Builders Committee in an important group of tests, the results of which were published in the Master Car Builders Proceedings for 1894. One of the most valuable results of these early tests made by Mr. Sargent was the construction of the Master Car Builders Brake Shoe Testing Machine on which full sized brake shoes could be tested. This machine, first installed at the plant of the Westinghouse Air Brake Company at Wilmerding, Pa., was transferred in 1898 to the laboratory of Purdue University. In 1891 Mr. Sargent resigned his position with the Chicago, Burlington & Quincy and became identified with the Congdon Brake Shoe Company of Chicago. In 1893 he became chief engineer of the Sargent Company, Chicago, and remained in that capacity until 1902, when the American Brake Shoe & Foundry Company was formed, at which time Mr. Sargent became its Chief Engineer. From the time Mr. Sargent became actively connected with the brake-shoe business he has had a part in every important development that has been made in brake shoes. He was largely responsible for the perfection of the expanded metal (Diamond-S) type of brake shoe, which was originally brought out in 1897. This development contributed largely to the structural strength and the wearing quality of brake shoes. He also had a large part in the development of the steel back reinforcement which was likewise a great contribution to safety as well as to the durability of the brake shoe. He also developed a special metal insert used in driver

F. W. Sargent

brake shoes and through his continued research in brake shoe problems has contributed many other important improvements. Shortly after becoming associated with the American Brake Shoe & Foundry Company he developed an improved full size brake-shoe testing machine, which was installed at this company's Mahwah, N. J., plant in 1908 and which machine he revised from time to time in order to keep pace with the ever-changing railroad conditions. An entirely new machine of this type, with greatly increased capacities for brake shoe and wheel loads and a materially increased speed range, only a little more than a year ago was installed in a new research laboratory built by the American Brake Shoe & Foundry Company at Mahwah, N. J., and fittingly named in honor of Mr. Sargent. Mr. Sargent was a member of the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers and the American Society for Testing Materials. He was the author of the "Development of the Modern Brake Shoe" and "Motor Car Builders Brake Shoe Tests" and numerous railway club papers.

HENRY S. DEMAREST, president and treasurer of Greene, Tweed & Co., N. Y., died at his home in Hempstead, N. Y., on July 11, at the age of 70. Since 1900, he had been associated with the company.

(*Turn to next left-hand page*)

Personal Mention

General

C. T. Ripley, chief mechanical engineer of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, has taken a leave of absence.

J. P. Morris, master mechanic of the Atchison, Topeka & Santa Fe at Chicago, has been appointed to the newly-created position of mechanical assistant in the general office at Chicago.

Ernest R. Lind has been apponted general mechanical inspector of the Northern Pacific, with headquarters at St. Paul, Minn., to succeed R. P. Blake, retired.

H. E. Hinds, chief draftsman (locomotive) of the Chicago, Burlington & Quincy, has been appointed assistant mechanical engineer, with headquarters as before at Chicago.

H. M. Wood, assistant master mechanic of the Pittsburgh division of the Pennsylvania at Pittsburgh, Pa., has been appointed assistant engineer, motive power, office of general superintendent motive power, Eastern Region with headquarters at Philadelphia, Pa.

J. M. Nicholson, master mechanic on the Atchison, Topeka & Santa Fe at Chicago, has been appointed acting mechanical superintendent of the Western Mechanical district of the Eastern lines, with headquarters at Topeka, Kan., replacing I. C. Hicks, who has been granted a leave of absence because of ill health.

Master Mechanics and Road Foremen

W. P. Hartman master mechanic of the Atchison, Topeka & Santa Fe at Slaton, Tex., has been transferred to Argentine, Kan.

Paul J. Danneberg, general foreman of the Atchison, Topeka & Santa Fe at Argentine, Kan., has been promoted to master mechanic of the Slaton division of the Panhandle & Santa Fe (part of the Santa Fe System), with headquarters at Slaton, Tex.

W. Ellison has been appointed acting division master mechanic of the Canadian National, with jurisdiction over Toronto Terminals—Toronto to Niagara Falls and Toronto to Fort Erie—succeeding W. Sharp, who has been granted a leave of absence.

Car Department

A. Leduc has been appointed car foreman of the Canadian National at Brockville, Ont., succeeding J. A. Hueston, retired.

C. F. Weaver, district car foreman of the Canadian National at Montreal, Que., has been appointed superintendent of the car shop at London, Ont., succeeding T. M. Hyman, retired.

Shop and Enginehouse

T. Clegg, air brake inspector of the Canadian National at Winnipeg, Man., has retired.

A. McDonald, night foreman of the Canadian National at Kamloops Junction, B. C., has retired.

A. D. McMillan, locomotive foreman of the Canadian National at Rocky Mountain House, Alta., has been transferred to Mirror, Alta.

J. T. Walton, locomotive foreman of the Canadian National at Mirror, Alta., has been transferred to Rocky Mountain House, Alta.

G. H. Murdock, a machinist of the Canadian National at Kamloops Junction, B. C., has been promoted to the position of night foreman.

J. Phelan, air brake foreman of the Canadian National at Fort Rouge, Man., has been appointed air brake inspector, western region, with headquarters at Winnipeg, Man., succeeding T. Clegg, retired.

Purchasing and Stores

V. R. Naylor, general foreman of the Southern Pacific at West Oakland, Calif., has been appointed district material supervisor to succeed C. S. Jones.

S. Sneddon, assistant general storekeeper of the Canadian National, at Winnipeg, Man., has been appointed general storekeeper of the central region, with headquarters at Toronto, Ont.

R. D. Long, purchasing agent of the Chicago, Burlington & Quincy, with headquarters at Chicago, has been appointed also general purchasing agent of the Colorado & Southern, the Fort Worth & Denver City and the Wichita Valley, all of which are subsidiaries of the Burlington.

Obituary

Joseph F. McAuley, division storekeeper on the Southern Pacific, with headquarters at Portland, Ore., died suddenly of a heart attack on June 21.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

Bethlehem Steels.—"Mayari Staybolt Steel" and "Bethlehem Silico-Manganese Spring Steel" are the subjects of Folders 386 and 387 issued by the Bethlehem Steel Company, Bethlehem, Pa.

Boring Bars and Reamers.—Specifications, prices and descriptions of Gisholt boring bars and reamers are contained in the eight-page illustrated bulletin issued by the Gisholt Machine Company, Madison, Wis.

Oil-Burning Rivet Forges.—Johnston Type A rivet forges equipped with non-clogging vacuum oil burners and monolithic fire brick linings are illustrated and described in Bulletin No. 200C issued by the Johnston Mfg. Co., Minneapolis, Minn.

Vascoloy-Ramet Tools and Blanks.—The Vanadium-Alloys Steel Company, Vascoloy-Ramet Division, North Chicago, Ill., has issued a catalog of tools and blanks which contains much useful data for tool makers using carbide blanks, or machine shops using tools tipped with these blanks.

Wrought-Steel Wheels and Axles—A symbolic replica of a wrought steel wheel is embossed on the front cover of a book entitled "USS Wrought-Steel Wheels and Axles" issued by the United States Steel Corporation Subsidiaries, 434 Fifth Avenue, Pittsburgh, Pa. The book is addressed to "The Safest Carrier in the World"—the railroads of today—and contains sections on wheels for steam railway service, wheels for electric railway service and forged steel axles

Steel Shop Boxes.—An attractive catalog, entitled Steel Shop Boxes, has been published by Lyon Metal Products, Incorporated, Aurora, Ill. This catalog completely illustrates and describes a wide range of steel boxes for every manufacturing and storage use—shelf boxes for the storage of small parts; shop and tote boxes for transportation of work in process by truck, conveyor or lift truck; stacking boxes, nesting boxes; and suggestions for the use of special steel containers designed to be used with specific production systems. In addition, the catalog contains brief descriptive matter on steel shelving, lockers, shop equipment and tool storage equipment.

Timken Bearings.—The 32-page folder, issued by the Railroad Division of the Timken Roller Bearing Company, Canton, Ohio, in timetable style, illustrates many applications of Timken bearings to railroad equipment. Eleven full-page cutaway illustrations show driver, truck and car applications now in standard service. Other illustrations show and describe various types of locomotives which have been Timken-equipped, as well as Diesel and steam powered, streamline high-speed trains. Timken light-weight reciprocating parts are described and easily read graphs show how Timken bearings reduce starting and operating friction and hold operating temperatures within safe limits, as well as how Timken rods and reciprocating parts reduce dynamic augment.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, Railway Master Mechanic, and Boiler Maker and Plate Fabricator. Name Registered, U. S. Patent Office

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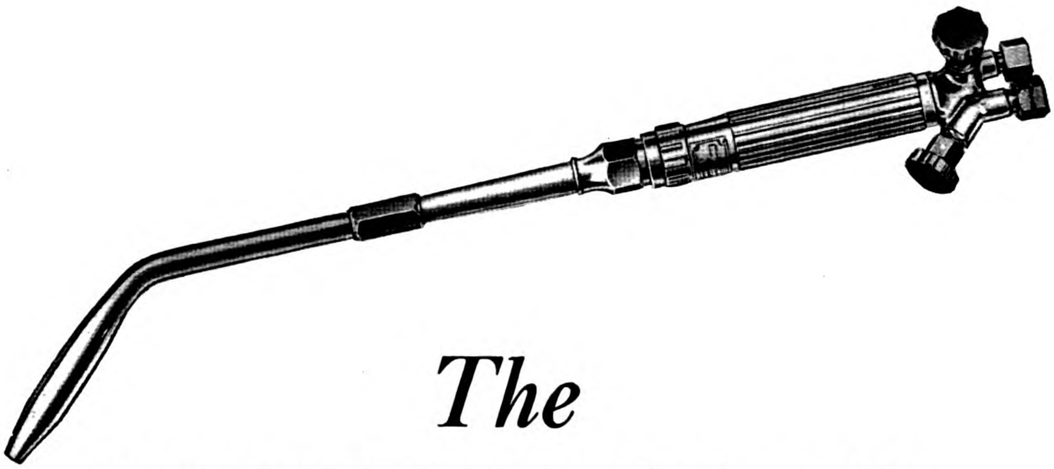

The OXWELD* W-24R WELDING BLOWPIPE

The Blowpipe for All Railroad Welding

THE Oxweld W-24R is an all-purpose oxy-acetylene welding blowpipe for railroads. Some of the important uses of this blowpipe include the repair of broken cylinders, frames and wheel centers, the building up of worn piston heads and driving-box surfaces, and the butt-welding of a rail.

The W-24R is well balanced and easy to handle. It has a choice of tip sizes which makes it adaptable for welding and heating operations ranging from sheet metal to heavy frame sections. This unusual capacity now makes profitable many large welding jobs for which railroads have been seeking an economical welding method. The Oxweld Railroad Service Company will gladly supply this improved blowpipe to its contract customers as rapidly as production will permit.

*Trade-Mark

THE OXWELD RAILROAD SERVICE COMPANY
Unit of Union Carbide and Carbon Corporation

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OXWELD RAILROAD SERVICE
1912-1937
A QUARTER OF A CENTURY OF SERVICE TO THE MAJORITY OF CLASS I RAILROADS

RAILWAY
MECHANICAL ENGINEER

Design Features of Lightweight

Modern Locomotive Equipment-II*

A discussion of the development and research problems involved in the design of Timken lightweight reciprocating and rotating parts for locomotives

The previously published part of this article[†] related the importance of lightweight revolving and reciprocating parts and compared the weights, dynamic augment on the rail, and the maximum horizontal force on locomotives equipped with Timken high-dynamic-steel rods and locomotives equipped with plain-bearing rods. [Editor.]

Design of Column Section of Rods

The design of the column sections of the main and side rods is based on compression tests of full-sized tapered columns. The columns tested were machined from standard structural-steel I-beam sections to dimensions comparable with those of full-size main and side rods used in service. The object of these tests was to determine the load required to bring failure due either

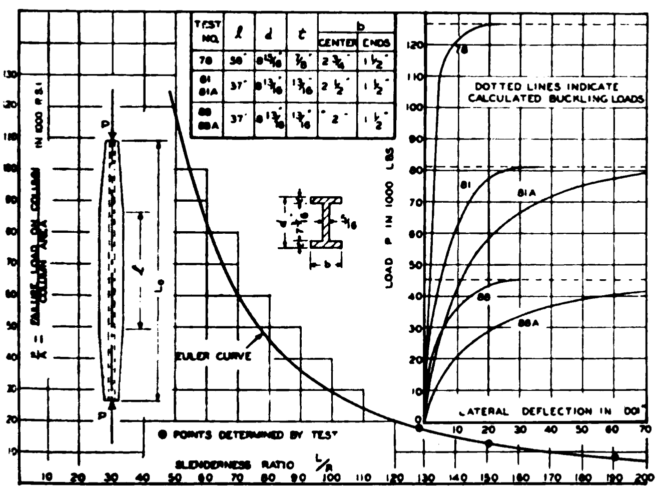


Fig. 5—Comparison of experimental and calculated buckling loads for tapered columns

to local yielding or to buckling. Only sufficient tests were made to satisfy the validity of formulas for the rational design of tapered columns.

The general shape and characteristics of the columns tested are shown by the sketches in Fig. 5. For a column tapered in the manner shown, the least moment of inertia of any cross section in the tapered portion at either end of the column is very nearly proportional to the cube of the ratio of the width of flange at that section to the width of flange at the end of the column. The buckling load for a pin-ended column of this kind is expressed by the equation

$$P_c = m\frac{EI}{L_0^2} = m\frac{EAR^2}{L_0^2} \quad \text{[1]}$$

where E = Young's modulus (30×10^6); I = least moment of inertia of the uniform section at the center of the column; A = cross-sectional area of this section; R = least radius of gyration of the same section; L_0 = over-all length of the column; m = coefficient (Dinnick's factor) dependent on the ratios l/L_0 and i/I; l = length of uniform part of the column; and i = least moment of inertia of the section at either end of the column. Values of the coefficient m were taken from a table for pin-ended tapered columns given in Dinnick's work[3] and the buckling load was calculated for each column tested as shown in Table V.

For a uniform column, Equation [1] for the buckling load reduces to Euler's formula

$$P_c = \pi^2\frac{EI}{L^2}$$

or

$$\frac{P_c}{A} = \pi^2\frac{E}{(L/R)^2} \quad \text{[2]}$$

where L = length of the uniform column; A = cross-sectional area; and R = radius of gyration of the cross section. From Equation [2] Euler's curve has been plotted in Fig. 5. A modified Euler curve could be drawn for each value of m encountered in the column tests, and individual test results could be compared with the corresponding curves. Instead of doing this, a simpler procedure was adopted for the comparison of test values with the values predicted by theory. For each column tested, the length L was calculated for an equivalent uniform column, having a cross section the same as that of the center part of the tapered column, which would buckle at the same load. Using this value of L, the test value of P_c/A for each column tested could

* Abstracted from a paper on "Modern Locomotive and Axle-Testing Equipment," by T. V. Buckwalter, O. J. Horger and W. C. Saunders, published in the transactions of the American Society of Mechanical Engineers, April, 1937, and presented before the semi-annual meeting, Detroit, May 17-21, 1937.

† Part I of this article was published on pages 348-351 of the August issue of the *Railway Mechanical Engineer.*

[3] "The Theory of Elasticity," by S. Timoshenko, McGraw-Hill Book Company, New York, 1936, p. 137.

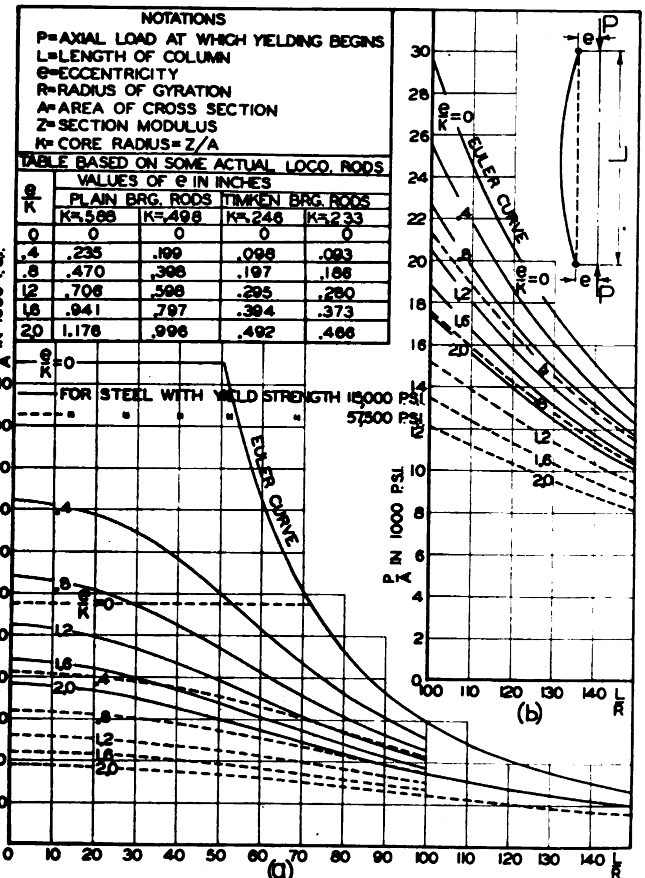


Fig. 6—Stress in columns of various slenderness ratios

be plotted against L/R for that column and the point so obtained should fall on Euler's curve.

Table V gives the dimensions and other data for three of the seventeen different designs of columns tested. The test results given in this table represent the results of five tests, one test on the first design and two each on the other two designs. In each case, the buckling loads for the two tests on the same design were identical. The load-deflection curves for these five tests are given in Fig. 5. The slope of each curve showing the lateral

Table V—Results of Tapered-Column Tests

Item	Test No. 78	Test No. 81 and 81A	Test No. 88 and 88A
d = depth of section, in.	$8^{15}/_{16}$	$8^{13}/_{16}$	$8^{13}/_{16}$
b = width of flanges at center, in.	$2\frac{3}{4}$	$2\frac{1}{2}$	2
A = area of I-section at center, sq. in.	7.06	6.30	5.49
I = least moment of inertia at center, in.^{4}	3.04	2.14	1.10
R = least radius of gyration at center = $\sqrt{(I/A)}$, in.	0.655	0.582	0.448
a = area of I-section at ends, sq. in.	4.86	4.67	4.67
i = least moment of inertia at ends, in.^{4}	0.507	0.475	0.475
l = length of uniform section, in.	58	37	37
L_0 = overall length of column, in.	83	83	83
l/L_0	0.70	0.45	0.45
i/I	0.166	0.220	0.431
m = Dinnik's factor	9.58	8.80	9.28
P_c = buckling load for column = mEI/L_0^2, lb.	127,000	81,500	45,400
P_c/A = average compressive stress at center, lb. per sq. in.	18,000	12,900	8,300
L = length of uniform column which would have the same buckling load, in.	84.2	87.8	85.5
L/R = slenderness ratio	128.5	150.8	191.0
P = buckling load from test, lb.	127,000	82,000	49,500

NOTE: Cylindrical blocks were used on ends of columns to give round-end conditions for the buckling tests.

deflection of the column at its center is due to slight and unavoidable imperfections in material, initial curvature of the column, and accidental eccentricity of the load applied in the test. For an ideal column, the curve would be truly vertical for loads up to the failure load. The actual curves are asymptotic to the horizontal dotted lines which show the theoretical calculated value of the buckling load for each column. The test value of P_c/A for each of the three designs listed in Table V is plotted against L/R in Fig. 5 as three points, which fall on the Euler curve. The close agreement of the experimental points with Euler's curve shows that the analytical work of Dinnik can be applied to find an equivalent value of L for a tapered column. This equivalent length will be greater than the actual length L_0 of the column, and the column may then be designed for safety from buckling or failure at the middle of the column as though it were a uniform column of length L. The experimental results presented in this paper in support of this idea were obtained from tests on tapered columns having very little eccentricity. However, additional tests on tapered columns were carried out in which the loads were applied with a deliberate eccentricity at both ends of the column. These tests showed that the correspondence between the measured deflections at the center of an eccentrically loaded tapered column and the calculated

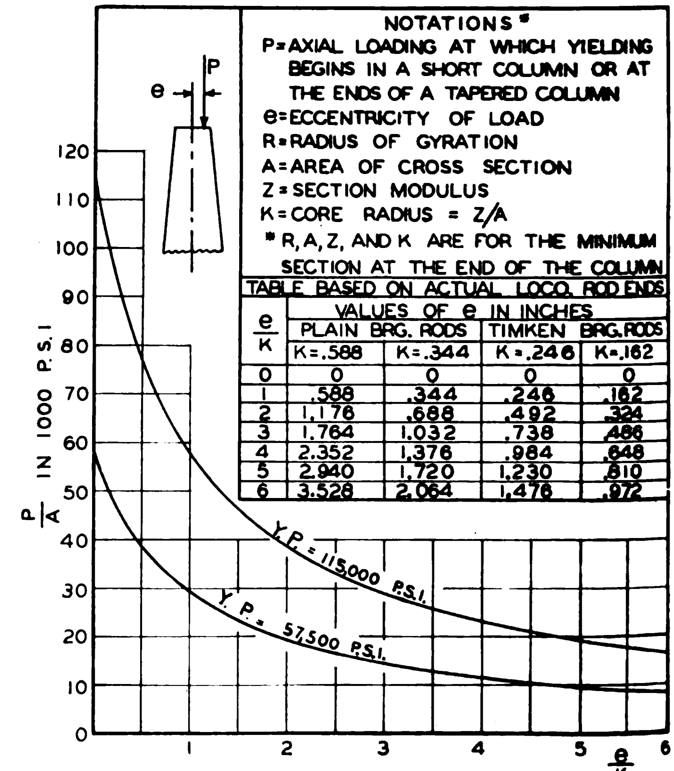


Fig. 7—Curves showing yielding stresses at the ends of eccentrically loaded tapered columns

deflections at the center of the equivalent uniform column, the length of which was determined as previously explained, was sufficiently close to warrant using the same equivalent length L for the design of a tapered column regardless of the amount of eccentricity assumed to exist in the application of loads.

With this in mind, we can proceed with a discussion of the failure of uniform columns. Euler's curve shown in Fig. 5 gives the buckling load for pin-ended columns with no eccentric loading. If we consider that a column has failed as soon as the yield-point strength has been exceeded, then the full-line curve designated as e/k = 0 in Fig. 6 gives the failure loads for columns with no eccentricity if the steel in the columns is of the Timken high-dynamic type, having a yield-point strength of 115,000 lb. per sq. in. The horizontal portion of this curve is below the value of L/R used for locomotive rods and is not of much interest to the designer. In a driving-

gear system, moreover, the load is sometimes eccentrically applied on the rod and develops stresses above the yield point as a result of the combination of bending stress with direct stress. The remaining full-line curves of Fig. 6 are also for a yield-point strength of 115,000 lb. per sq. in., and show the loads at which yielding at the center of a uniform column will begin for several assumed values of the ratio e/k. The curves shown in Fig. 6 were calculated using the equation

$$\frac{P}{A} = \frac{\text{Yield-point strength}}{1 + \frac{e}{k} \sec \frac{1}{2}\frac{L}{R}\sqrt{\left(\frac{P}{EA}\right)}} \quad [3]$$

the notations for which are given in Fig. 6. The dashed-line curves of Fig. 6 give the same information as the full-line curves, only for a steel having a yield-point strength of 57,500 lb. per sq. in. Fig. 6 shows both groups of curves for values of L/R up to 150. In Fig. 6*b* is given that portion of the curves to an enlarged vertical scale for L/R values of 100 to 150 which are commonly used in locomotive-rod design.

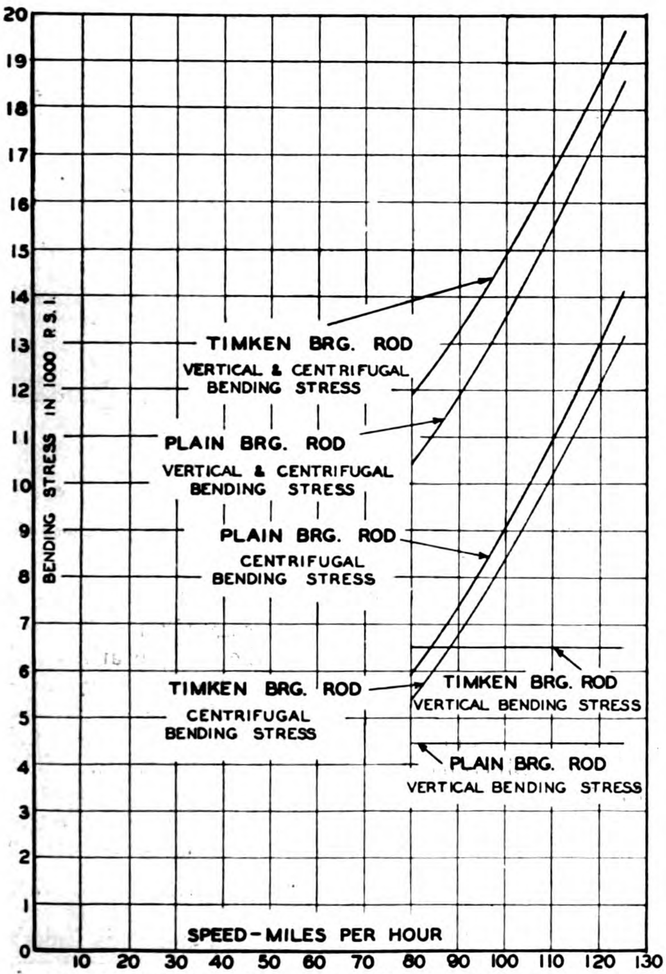


Fig. 8—Vertical bending and centrifugal stress in main rods

The curves of Fig. 6 furnish a basis for the rational design of columns by assuming some eccentricity and utilizing steels with higher yield strength. The factor of safety for any column will be the ratio of the load at which the column will yield to the maximum load which the column must carry. It is apparent from Fig. 6*b* that with equal eccentric loading (say $e/k = 2.0$) the higher-yield strength steel will give a column strength 24 to 43 per cent greater than the lower-yield-strength steel for L/R ratios of 150 and 100, respectively. As mentioned before, the narrow width of the ends of the Timken rods and the well-maintained alignment of the driving axles and driving-rod system through the use of Timken roller bearings permits small eccentric loading compared to plain-bearing rods. Assuming that e/k may be reduced from 2.0 to 1.0, then Timken rods made from steel with a high yield strength will have a strength of from 40 ($L/R = 150$) to 76 per cent ($L/R = 100$) greater than plain-bearing rods of the same weight made from steel with low yield strength. Or by maintaining the same column strength in designs using both steels, the Timken rods will show a saving in weight.

While the curves of Fig. 6 illustrate saving in weight effected by using steel of high yield strength for uniform columns, we will also show by Fig. 7 that the use of the same steel gives additional weight saving by increasing the amount of taper which may be permitted at the ends of the columns or rods. When the ends of a column are tapered, failure may develop due to local yielding at the ends of the column before buckling or yielding occurs in the middle. The stress at the end of a column is independent of deflections, so that the maximum combined stress at the end of a tapered column is simply

$$\frac{P}{A} + \frac{Pe}{Z} \quad [4]$$

where the notations are those in Fig. 7. To find the value of P/A at which yielding will begin at the end of a column it is only necessary to equate this stress to the yield-point strength of the material. Fig. 7 gives curves showing the values of P/A at which yielding will begin at the ends of a tapered column, one curve for the Timken high dynamic steel having a yield point strength of 115 000 lb. per sq. in., and the other for a steel having a yield strength of 57,500 lb. per sq. in. The curves

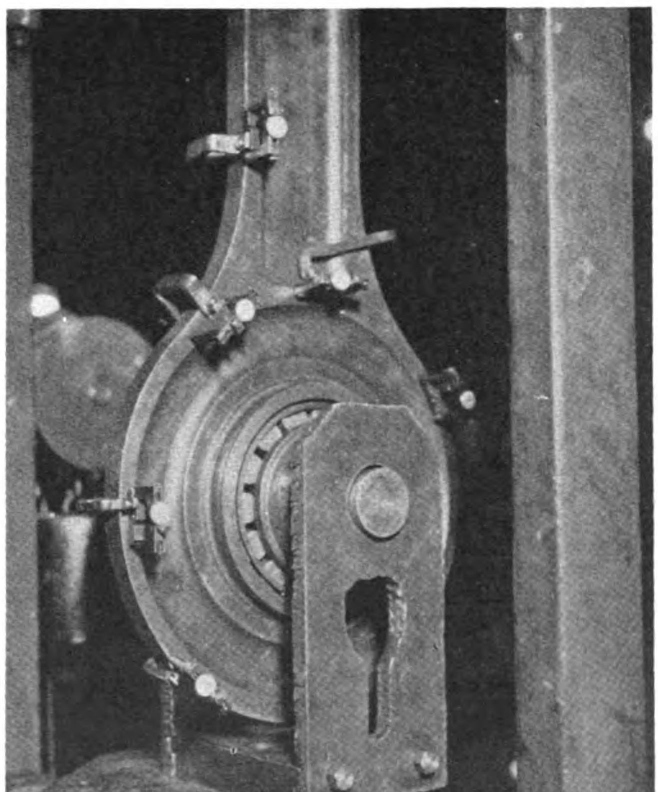


Fig. 9—Side rod in test setup showing arrangement of strain gages used to determine stress distribution in various eye sections

Table VI—Summary of Stresses at Sections *U* and *N* of Side-Rod Eyes Shown in Fig. 10

	Section *U* — Stress, lb. per sq. in. — P/2A (B)	Section *U* — Stress, lb. per sq. in. — Test (C)	Section *U* — Ratios — (C)/(B)	Section *U* — Ratios — (D)/(E)	Section *N* — Stress, lb. per sq. in. — P/2A (B)	Section *N* — Stress, lb. per sq. in. — Test (C)	Section *N* — Ratios — (C)/(B)	Section *N* — Ratios — (D)/(E)
Design No. 1:								
Pin clearance = 1/64 in.	7,500	23,500(E)	3.13	1.13	7,500	11,300(E)	1.51	1.67
Pin clearance = 5/64 in.		26,500(D)	3.53			18,900(D)	2.52	
Design No. 2:								
Pin clearance = 1/64 in.	7,200	23,600(E)	3.28	1.20	6,500	9,600(E)	1.48	2.17
Pin clearance = 5/64 in.		28,200(D)	3.92			20,800(D)	3.20	

show that the value of P/A to cause yielding for a given column end section is directly proportional to the yield-point strength of the material used. In using the curves in Fig. 7 it should also be considered that here again much less eccentric loading may be expected on the narrow Timken rods than on the wide plain-bearing rods for the reasons previously mentioned.

On the basis of the test results and theoretical considerations presented previously in this paper, we conclude that tapered-column sections used in locomotive main and side rods may be designed for safety against sidewise bending and direct stress by the use of curves derived from rational formulas. It should be mentioned here that empirical formulas similar to those used by A.A.R. and locomotive builders do not permit the proper evaluation of the advantages to be obtained by using higher-yield-strength steel and tapered-column design.

Fatigue Failure of Rods

Up to this point, only static failure of the columns has been considered, but the possibility of fatigue failure must also be investigated. Fatigue failures seldom occur in the uniform-column portion of the rod, but usually develop at the junction of the column with the eye (fatigue failures in the eye will be discussed later). In this region there is usually an abrupt change in section, and the bending and direct stresses are higher than the nominally calculated values due to stress concentration. The Timken-rod design gives comparatively uniform sections at the junction of the eye and column which results in less stress concentration and greater uniformity of strength of material than in plain-bearing rods. Danger of fatigue failure in the Timken rods is further reduced by the high fatigue strength of the high dynamic steel.

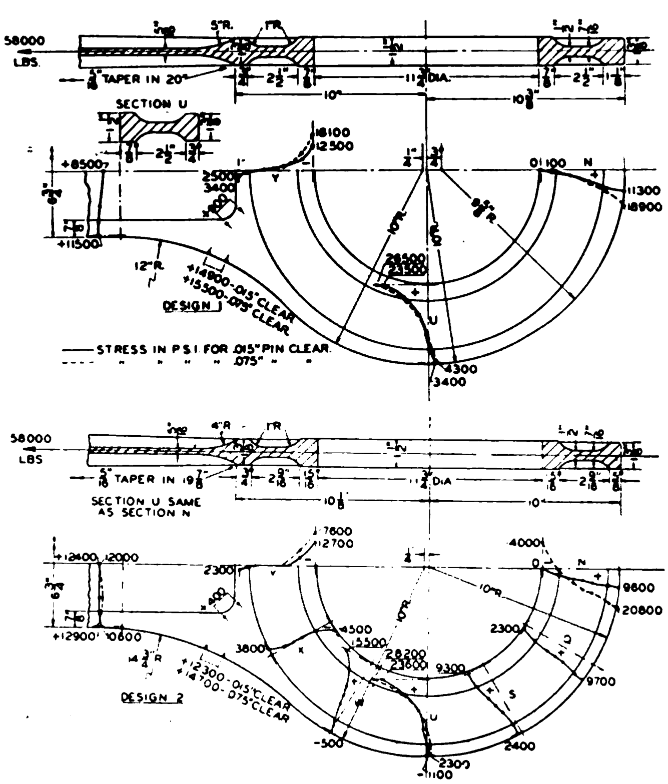


Fig. 10—Stresses and dimensions of side-rod eyes tested

Vertical Bending and Centrifugal Stresses

At low speeds, only sidewise bending and direct stress need be considered. At high speeds, however, stresses due to vertical bending caused by the column load and

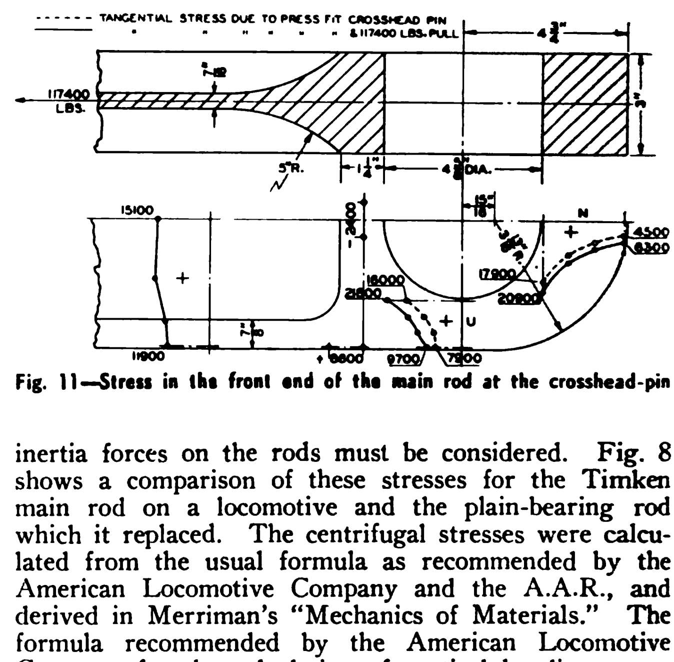


Fig. 11—Stress in the front end of the main rod at the crosshead-pin

inertia forces on the rods must be considered. Fig. 8 shows a comparison of these stresses for the Timken main rod on a locomotive and the plain-bearing rod which it replaced. The centrifugal stresses were calculated from the usual formula as recommended by the American Locomotive Company and the A.A.R., and derived in Merriman's "Mechanics of Materials." The formula recommended by the American Locomotive Company for the calculation of vertical bending stress S in a rod, is an empirical formula which can be written

$$S = \frac{P/2A}{1-(P/2P_c)} \quad \text{[5]}$$

where P is the maximum piston thrust, and P_c is Euler's load for buckling in the vertical plane as given in Equation [2], considering each rod as a round-ended column. The curves for vertical bending stress given in Fig. 8 were calculated from this formula. Fig. 8 shows also the combined stress, vertical bending plus centrifugal, for the Timken rod and the plain-bearing rod. It will be seen that the combined stress is slightly higher for the Timken rod because of its reduced section. The higher stress in the Timken rod is more than offset by the higher physical properties of the steel used as compared with the properties of the steel used for plain-bearing rods.

The practice of combining vertical with centrifugal stress, as in Fig. 8 is recommended by the American Locomotive Company. The standard practice of the A.A.R. is to combine direct stress due to a fraction of the full piston thrust with centrifugal stress. The latter

method would give slightly lower stresses than those shown by the curves in Fig. 8.

Design of Eye Ends of Driving Rods

A satisfactory analytical solution for the stresses in the eye ends of the main and side rods does not exist. This is due to the difficulty of determining the load distribution over the bore of the rod eye which depends upon the clearance between the eye and the bearing race. This clearance is a minimum for new parts and, since increased clearance results in higher stresses in the eye sections of the rod, the stresses in these sections become

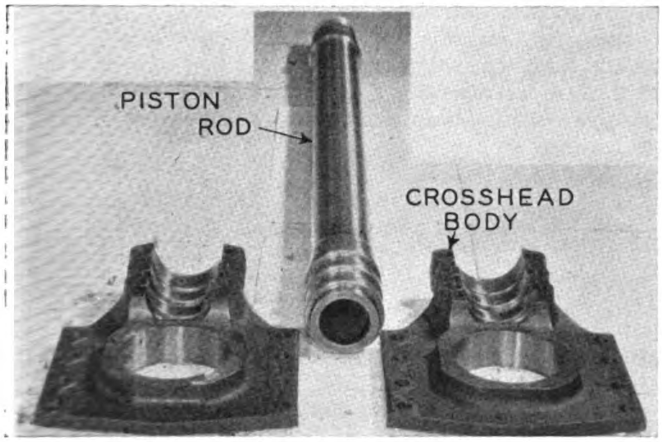


Fig. 12—The two halves of the die-forged crosshead body are bolted together over a system of annular grooves in the piston rod to form the crosshead connection

greater as the clearance increases under operating conditions. The purpose of these static tests on full-size eye sections, therefore, was (*a*) to investigate the stress distribution in various designs of eye sections, and (*b*) to determine the increased magnitude of these stresses due to increasing the clearance from minimum to maximum values anticipated in service. These tests were made on side rods and the knowledge obtained was applied in an analytical solution for the stresses in the main rods which are of similar design. In addition to the stresses measured in these static tests, stresses due to impact are present in the eye sections under operating conditions and this must be considered when a factor of safety is selected.

The method of loading the eyes of the side rod in the testing machine to determine the stress distribution by means of last-word strain gages of 1-in. gage length located at various I-sections is shown in Fig. 9. The complete stress distribution was determined in the eye section for ten different rod conditions which included readings were made, most of which were obtained from tensile tests on the rods and the remainder from compression tests. A load of 58,000 lb. (one-half the piston thrust) was applied on the side-rod eye in all these tests which is in accordance with A.A.R. design specifications

Table VII—Summary of Stresses Due to Both 0.004-in. Press Fit of Crosshead Pin and 117,400-Lb. Pull on the Main Rod—See Fig. 11

	Section U	Section N
(A) Measured stress, lb. per sq. in.	21,800	20,900
(B) Stress P/2A, lb. per sq. in.	13,000	8,100
(C) Ratio (A) (B)	1.68	2.58

for the six-coupled passenger locomotive on which this rod application was made. The results of two of the tension tests on each of the two designs of eyes in Fig. 10 are shown graphically in that figure. Strain gages could not be mounted closer than $\frac{1}{16}$ in. from the boundary of the rod so that stresses at this position are given in the table of Fig. 10 rather than stresses extrapolated to the boundary.

Referring to Fig. 10, it is apparent that the critical stresses measured in test occur at sections *N* and *U* with the latter showing the maximum stresses. Actually the maximum stresses exist a short distance from section *U*, depending upon the clearance in the eye, but the difference from the values shown would be small. Table VI, comparing the stresses in the two designs of the eye, shows slightly lower stresses for design 1 than for design 2, particularly with increased pin clearance. The

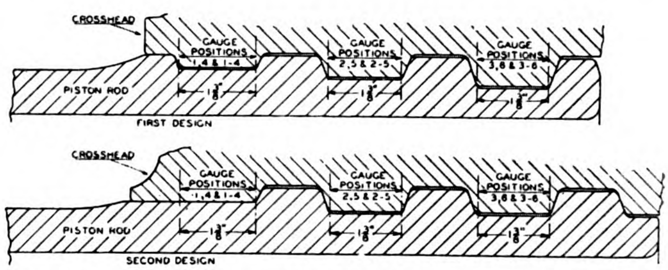


Fig. 13—Gage locations used in determining stresses in the piston rod

thinner rim in design 2 would tend to increase the stress over design 1. The effect of $\frac{5}{64}$ in. pin clearance instead of $\frac{1}{64}$ in. clearance is to increase the stresses by 13 to 20 per cent at section *U*, but is of greater influence at section *N* where the stresses with $\frac{5}{64}$ in. clearance are 1.7 to 2.2 times as great as the stresses with $\frac{1}{64}$ in. clearance. The measured stresses given in the table in Fig. 10 for section *U* are 3.1 to 3.9 times the nominally calculated direct stresses, *P/2A*, and are 1.5 to 3.2 times as great as *P/2A* at section *N*, which indicates the presence of considerable bending at these sections.

Table VIII—Total Stress in Piston Rod Due to Tightening Crosshead Bolts and to a Pull of 120,000 Lb.

Gage position as shown in Fig. 13	Design No. 1 — Stress due to tightening 6 bolts, lb. per sq. in.	Design No. 1 — Stress due to 120,000 lb. pull, lb. per sq. in.	Design No. 1 — Total stress, lb. per sq. in.	Design No. 2 — Stress due to tightening 6 bolts, lb. per sq. in.	Design No. 2 — Stress due to 120,000 lb. pull, lb. per sq. in.	Design No. 2 — Total stress, lb. per sq. in.
1	0	4,300	4,300	−9,500	19,000	9,500
4	1,300	−3,700	−2,400	−12,000	17,000	5,000
1-4	12,000	8,800	20,800	1,000	13,000	14,000
2	8,000	2,600	10,600	15,000	4,000	19,000
5	5,500	20,500	26,000	22,000	4,000	26,000
2-5	4,500	4,500	9,000	12,000	9,000	21,000
3	44,000	1,000	45,000	13,000	2,500	15,500
6	19,000	26,000	45,000	14,000	2,500	16,500
3-6	2,100	4,900	7,000	−600	5,600	5,000

Note: Stresses are those at the bottom of the annular grooves in the piston rod as shown by the gage positions in Fig. 13.

the investigation of five different eye designs having various clearances between the eye and the outer race of the Timken bearing. A total of 1,300 strain-gage

As a result of the test data given and additional tests not shown, the final design of rod introduced in service

(*Continued on page 405*)

Railway Fuel and Traveling Engineers' Association

Grand Ballroom, Hotel Sherman

Tuesday, September 28—General Session

Morning Session

10:30 o'clock	Convention called to order.
10:45 o'clock	Chairman's address by J. D. Clark, fuel supervisor, Chesapeake & Ohio.
11:00 o'clock	Address by M. J. Gormley, executive assistant to president, Association of American Railroads.

Afternoon Session

2:00 o'clock	Report on Fuel Records and Statistics, by E. E. Ramey, fuel engineer, Baltimore & Ohio.
	Address by Roy V. Wright, editor, Railway Mechanical Engineer.

Wednesday, September 29—Mechanical Day

Morning Session

9:30 o'clock	Report on New Locomotive Economy Devices, by A. G. Hoppe, assistant mechanical engineer, Chicago, Milwaukee, St. Paul & Pacific.
10:15 o'clock	Report on Steam Turbine and Steam Condensing Locomotives, by L. P. Michael, chief mechanical engineer, Chicago & North Western.
11:00 o'clock	Address by W. H. Flynn, general superintendent motive power and rolling stock, New York Central.
11:30 o'clock	Report on Front Ends, Grates and Ashpans, by Prof. E. C. Schmidt, University of Illinois.

Afternoon Session

2:00 o'clock	Report on Attention to Valve Motion and Its Effect on Fuel Economy, by M. F. Brown, fuel supervisor, Northern Pacific.
3:00 o'clock	Report on Utilization of Locomotives, by A. A. Raymond, supervisor of fuel and locomotive performance, New York Central.

Thursday, September 30—Air Brake Day

Morning Session

9:30 o'clock	Report on Air Brakes, by W. H. Davies, superintendent air brakes, Wabash.
11:00 o'clock	Address by L. K. Sillcox, first vice-president, New York Air Brake Company.

Afternoon Session

2:00 o'clock	Report on Locomotive Firing Practice—Oil, by R. S. Twogood, assistant engineer, Southern Pacific.
	Report on Locomotive Firing Practice—Coal, by W. C. Shove, general fuel supervisor, New York, New Haven & Hartford.

Friday, October 1—Fuel Day

Morning Session

9:30 o'clock	Report of Subjects Committee.
9:45 o'clock	Report on Inspection, Preparation and Utilization of Coal, by W. R. Sugg, superintendent fuel conservation, Missouri Pacific.
	Address by Eugene McAuliffe, president, Union Pacific Coal Company.
	Report of Secretary-Treasurer T. Duff Smith.
	Report of Finance Committee.
	Report on Constitution and By-Laws.
	Election of Officers.

Afternoon

No session scheduled in order that members may use all of this period for visiting exhibits.

C. I. Evans,
Vice Chairman

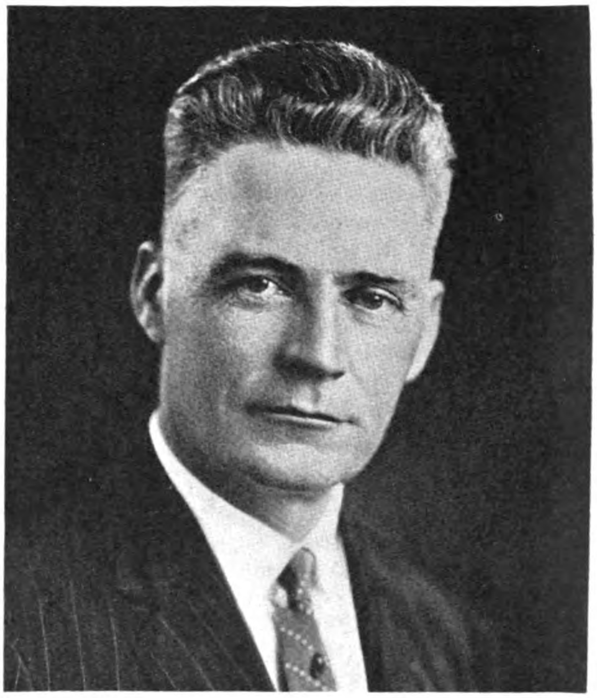
A. T. Pfeiffer,
Vice Chairman

F. P. Roesch,
Vice Chairman

T. Duff Smith,
Secretary-Treasurer

Fuel and Traveling Engineers

A consolidation of two powerful organizations meets at Chicago for first time Sept. 28—Oct. 1



J. D. Clark, Chairman

THE Railway Fuel and Traveling Engineers' Association will hold its first annual meeting in the Grand Ballroom of the Hotel Sherman, Chicago, September 28, 29, 30 and October 1. In point of program and tradition, however, it will not be a new association. Created by the merging of the Traveling Engineers' Association and the International Railway Fuel Association, it has a background of fine service to American railways, extending back for 45 years in the case of the former and 30 years in the case of the latter.

Traveling Engineers' Association

The Traveling Engineers' Association was organized January 9, 1893, in the office of Locomotive Engineering at the invitation of Angus Sinclair and John A. Hill, widely known as the creator of "Jim Skeever," whose "Object Lessons" are still fresh in the minds of the older men in railway service today. The chairman of the committee which issued the call for the meeting was C. B. Conger of the Chicago & West Michigan, who became the first president of the association organized that day "to improve the locomotive engine service of American railways." At the end of five years' service Mr. Conger was succeeded by D. R. MacBain, who later served as president of the International Railway Fuel Association and who was also president of the American Railway Master Mechanics' Association. Starting with a membership of 98 by the time of the first annual meeting held in September, 1893, it grew steadily. At the end of 10 years it had passed the 400 mark; at the end of 20 years it reached nearly 1,000, and for the five years ended with 1930 was above 1,500.

The membership policies of the Traveling Engineers' Association have been consistent throughout its history. Those eligible for active membership were traveling engineers or road foremen of engines and their assistants; promoted road foremen of engines; air-brake experts employed by the railroads and the manufacturers; general foremen, and roundhouse foremen. Associate members were "those whose knowledge of locomotive running and management will be of service to the association." Membership provisions were liberalized on several occasions, but only to the extent of making all general foremen and enginehouse foremen eligible, irrespective of former service as locomotive engineers, and by according associate members the privilege of promotion to full membership. The program of the association was developed consistently in keeping with the motto of the association "to improve the locomotive engine service of American railways."

A wide range of subjects has been covered in the pro-

ceedings. Among those most consistently included in the programs are air-brake and train handling, lubrication, and fuel economy. Smoke prevention commanded the attention of successive conventions for a number of years prior to 1918. The problems of employment and promotion in the engine service, including formulation of standard examinations, received considerable attention during the first 20 years of the association's history. Each new facility, such as the brick arch, the superheater and the stoker, as it came into use on the locomotive was the subject of study until it had become well established and its management generally understood. This part of the work of the association was, in fact, that of an organization of educators gathering material and formulating methods for the instruction of the men in the engine service.

One of the remarkable facts concerning the Traveling Engineers' Association is that this organization, one of the oldest in the field, was served as secretary throughout its history by one man—W. O. Thompson. Mr. Thompson was one of the organizers of the association and his secretaryship was unbroken until his death early in 1936.

Fuel Association Organized

When the Traveling Engineers' Association was 15 years old there came into being a new association designed to specialize on certain phases which had consistently been a part of the Traveling Engineers' program. On November 20, 1908, a group of some 40 persons met in Chicago for the purpose of organizing an association to advance the interests of the railroads by recommending the adoption of the best methods of purchasing, inspecting, weighing, distributing, handling and accounting for fuel. Membership in this organization was to include officers of railways and their assistants in charge of these functions as well as men in charge of fuel tests or economies on railways. Eligibility for associate membership included officers or representatives of concerns "engaged in production of fuel, either coal or oil, fuel handling, fuel-handling devices and equipment, fuel-consuming or labor-saving devices," and also men "whose general knowledge of fuel problems may be of value to the association." Eugene McAuliffe, then general fuel agent of the Rock Island-Frisco Lines, was elected president of this organization. At the time of the first annual meeting in June, 1909, the association had a membership of 200 and 117 were in attendance at the meeting.

Like the Traveling Engineers', this association prospered. At the end of 10 years its total membership was nearly 1,000. During the three or four years preceding the depression the active membership, consisting exclusively of railway men, exceeded 1,000, and the total membership varied from 1,400 to 1,600. In addition to the wide range of subjects included within the field which the association took for itself, it gradually devoted more and more attention to problems pertaining to the use of fuel. One of its most frequently repeated committee reports dealt with firing practice and another, of somewhat later origin, with front ends, grates and ash pans. The problems of locomotive maintenance effecting fuel economy were also constantly before the association.

In 1920 following the amalgamation of the Master Car Builders' and the American Railway Master Mechanics' Associations into the Mechanical Section of the American Railway Association, whereby these organizations lost their voluntary status, the question as to whether the so-called minor associations were to maintain their independence was raised in various ways. Both the Traveling Engineers' Association and the Fuel Association maintained their voluntary status and during the 1920's reached the peak of their success. During this period the Fuel Association contributed invaluable aid in the work of the Joint Committee on Fuel Conservation and Locomotive Utilization of the American Railway Association.

The Two Organizations Unite

Then came the depression. One of its early effects was to curtail association activities and, indeed, in the case of some of these organizations, to discontinue their activity completely. Following 1930 no meeting of the Traveling Engineers' Association was held until 1934, at which time a limited program was discussed by a meager attendance. No meeting of the International Railway Fuel Association was held in 1931 and 1932, although the reports and papers prepared for 1931 were published in a volume of Proceedings for that year. The meetings in 1933 and 1934 were limited in attendance. In 1935 the membership of the Fuel Association had dropped to 230. The situation seemed desperate from the viewpoint of both associations.

Thus was the soil prepared for the serious consideration by both bodies of the proposal that they combine their strength in a single association. This proposal was not new, although it had never received serious open consideration by either association. Many of the members and many other railway officers had long felt that the extent to which the programs of the two associations overlapped and the large overlap in membership made such a move highly desirable. Indicative of the overlapping membership is the list of men who had held the presidency of both associations. These included D. R. MacBain, W. C. Hayes, J. B. Hurley, J. N. Clark and J. M. Nicholson who presided at the meetings of both of these associations in 1934. Many others were active leaders in the work of both associations.

The union of the two associations into the Railway Fuel and Traveling Engineers' Association was ultimately completed in 1936. At that time simultaneous meetings of the two associations acted favorably upon the report of the Joint Committee recommending the merger and formulating the procedure for its accomplishment. The two organizations, each with a history of highly useful service to American railroads, are now joining forces in keeping with the logic of changed conditions and with renewed prospects of a continuing career of usefulness.

President Clark

James Daniel Clark, president of the association, is fuel supervisor of the Chesapeake & Ohio. He was born in Spotsylvania County, Va., January 27, 1883, and entered the service of the Chesapeake & Ohio as a fireman two days before Christmas, in December, 1903. He was promoted to locomotive engineer in 1911, became a traveling fireman in June, 1923, fuel instructor in August, 1924, and was made fuel supervisor, the position he now holds, in January, 1925. Mr. Clark was an active worker in both the International Railway Fuel Association and the Traveling Engineers' Association. He joined the Fuel Association in 1923, was elected a member of the executive committee in 1926, and vice-president in 1929. He was elected a member of the executive committee of the Traveling Engineers' Association in 1928 and vice-president in 1930. He was therefore the logical person to be elected to the presidency of the new association when it was formed a year ago.

Mr. Clark is a man of pleasing personality, yet direct

(Continued on page 403)

A. F. Stiglmeier,
Secretary-Treasurer

M. V. Milton, President

W. N. Moore,
Vice-President

Master

Boiler Makers Association

THE Master Boiler Makers' Association will hold a two-day convention in the Crystal Room, Hotel Sherman, Chicago, Wednesday and Thursday, September 29-30, 1937. Evidence of the splendid way in which this organization has come out of the depression is indicated by the considerable number of pertinent committee reports scheduled in the program, in addition to the special addresses.

After five long years of inactivity, this association, in 1935, commenced its rehabilitation in the face of considerable objection and under the handicap of a depleted membership. The action taken at its first business meeting in that year, which replaced the conventions of former days, more or less paralleled that at the inception of the association in November, 1902, and about the same number of representatives from railway boiler departments were in attendance. With the background of usefulness to the railroads established over the 35 years of its existence, the renewal of member interest has been very rapid. At the meeting in 1936 more than 150 members demonstrated their loyalty to the association by attending, and in that year nearly 350 former members again became active.

As the time for the 1937 business meeting of the Master Boiler Makers' Association approaches, it is apparent that the energy and aggressiveness of the organization in its own behalf through the period of its rebirth is bearing fruit in an added prestige and in the support of railroad officials generally.

To find the reason for this present support and interest in the association, it is probably necessary to go back to the beginnings of the organization, for its fundamental ideals have never been altered in the face of changing conditions. The purpose then and now has been one of service to the railroads.

Organized in 1902

Having in mind the value of education in the advancement of any craft, a group of enterprising boiler-shop foremen and supervisors met in the assembly hall of the Lindell Hotel in St. Louis, Mo., on November 11, 1902, to consider the formation of an association of railway boiler supervisors. The meeting culminated in action which started the International Railway Master Boiler Makers' Association on its career. It was conceived solely as an organization of those in charge of the railway boiler departments and to be controlled by officers having the complete sanction of railway management.

The association had these objects in view—to bring together for discussion among its members various topics of interest; to promote the exchange of ideas and methods used by various railroads in building, inspecting and repairing locomotive boilers, and to hold frequent meetings to promote a better acquaintanceship among members and thus to improve the standing and widen the influence of this branch of the railway industry.

Other than the appointment of officers and the selection of topics for discussions at a 1903 meeting, little else was accomplished during the November, 1902, session. The officers elected at that time were: President, F. J. Graves, master boiler maker, Chesapeake & Ohio, Huntington, W. Va.; first vice-president, J. A. Doarnberger, Norfolk & Western, Roanoke, Va.; second vice-president, William H. Laughridge, Hocking Valley, Columbus, O.; secretary and treasurer, P. Sullivan, Big Four, Urbana, Ill.; assistant secretary, E. C. Cook,

Master Boiler Makers' Association

Crystal Room, Hotel Sherman

Tuesday, September 28

6:30 to 7:30 p.m. Registration of Members and Guests.

Wednesday, September 29

Morning Session

7:30 to 9:30 a.m. Registration.
10:00 a.m. Business session.
10:05 a.m. Meeting called to order.
Annual address by President M. V. Milton.
Routine business.
Address by D. C. Buell, Director, Railway Educational Bureau, Omaha, Neb.
Annual report of the Secretary-Treasurer.
Miscellaneous business.
New business.
Appointment of special committees to serve during meeting.
Memorials.
Announcements.
Topic No. 7. Topics for 1938 Meeting. George M. Wilson, Chairman.

Afternoon Session

1:15 to 1:45 p.m. Registration.
2:00 p.m. Meeting called to order.
Committee report on topical subjects.
Topic No. 1. Pitting and Corrosion of Locomotive Boilers and Tenders. Louis R. Haase, district boiler inspector, Baltimore & Ohio, chairman. A representative of the Water Service Committee of the American Railway Engineering Association will discuss the report.
Topic No. 5. Improvements to Prevent Cracking of Firebox Sheets Out of Staybolt Holes. C. W. Buffington, general master boiler maker, Chesapeake & Ohio, chairman.
Topic No. 8. Law.—Myron C. France, general boiler foreman, Chicago, St. Paul, Minneapolis & Omaha, chairman.
Announcements.

Thursday, September 30

Morning Session

7:45 to 8:30 a.m. Registration.
9:00 a.m. Meeting called to order.
Unfinished business.
Annual address by Secretary-Treasurer Albert F. Stiglmeier.
9:30 a.m. Address by Col. C. C. Stibbard, chief operating officer, Board of Railway Commissioners, Ottawa, Ont.
Topic No. 2. Autogenous Welding and Cutting as Used with the Fabrication of Boilers and Tenders. Albert F. Stiglmeier, foreman, boiler department, New York Central West Albany Shops, chairman. In the discussion of the report a special paper will be presented by the Welding Section of the National Electrical Manufacturers Association on Code Requirements for Welded Seams; one by the International Acetylene Association on Heat Effects on Sheets When Cut by the Acetylene Process; another from the Lincoln Electric Company on What the Development of Coated Electrodes Has Done for the Railroads; and one from the Lukens Steel Company on Heat Effects on Welded Sheets.
Topic No. 3. Proper Thickness of Front Tube Sheets.
Announcements.

Afternoon Session

1:30 to 1:45 p.m. Registration.
2:00 p.m. Meeting called to order.
Announcements.
Topic No. 4. Improvements in Safe Ending and Application of Flues and Tubes. Frank A. Longo, welding and boiler supervisor, Southern Pacific, chairman.
Topic No. 6. What is Being Done to Prevent Back Tube Sheets from Cracking in Radius of Flange and Out of Tube Holes. Louis Nicholas, general boiler foreman, Chicago, Indianapolis & Louisville, chairman.
Report of chairman of Executive Board.
Election of officers.
For the good of the association.
Adjournment.

Railway Journal, St. Louis, Mo. Of this original group of officers, J. A. Doarnberger, and William H. Laughridge, present treasurer of the association, are still extremely active in the conduct of its affairs. At the first meeting 68 representatives were in attendance. These constitute the charter membership of the association.

The second convention was held May 19 to 21, 1903, at the Great Southern Hotel, Columbus, O. At this meeting the first committee reports were read and discussed with much interest and profit. That year 37 new members were added to the rolls of the association.

Rival Organizations

Through this period of its development a rival organization—the Master Steam Boiler Makers' Association, which also had been organized in 1902—grew to a position of such influence in the trade that steps were inaugurated in 1905 to amalgamate the two groups. Membership in the Master Steam Boiler Makers' Association was not confined to the railway boiler department but embraced the contract boiler and tank fields as well, with the result that membership in it had developed more rapidly than in the railway master boiler makers' group.

It was not until 1907, however, that complete accord was reached on the proposal to unite the two associations. In May of that year the first joint convention was held at the Hollenden Hotel, Cleveland, at which the name International Master Boiler Makers' Association was adopted to designate the combined organization. This union of rival groups brought the membership to 335. It was at this meeting that Harry D. Vought began his career as secretary of the association, which continued until his death in 1929.

In 1911, at the convention held at the Rome Hotel, Omaha, Neb., the International designation was dropped and the organization has since been known under its present name of Master Boiler Makers' Association. At that time the membership totaled 440 which indicates the increased interest that its work had developed throughout the craft.

Master boiler makers from every railroad were quick to realize the benefits to be derived from the organization and throughout its history, through good years and lean, this spirit never faltered. During the peak of activity in 1919, mainly through the efforts of Frank McManamy, then assistant director of operations of the United States Railroad Administration, the association boasted a membership of 631.

Never Stopped Fighting

Thus, well established and secure in a strong active membership, the association continued in a prosperous state throughout the 1920-1930 period with but little change in the procedure of working out its destiny. This riding the crest, however, came to an end with the evil days of the depression and the struggle of keeping an inactive association alive began. Under the guidance of Kearn E. Fogerty, of the Chicago, Burlington & Quincy, the president elected in 1930, and the present secretary, Albert F. Stiglmeier, general boiler foreman of the New York Central, and other officers, the problem was approached with courage and imagination.

While it was not possible to hold the 1931 convention, complete proceedings were published of all reports and addresses prepared for the meeting that year. These proceedings were distributed throughout the membership. Two years later, when no sign was forthcoming that a convention could be held, a complete "Convention in Print" was made available in October, 1933, through the medium of *The Boiler Maker.* This activity at the low point of the depression stimulated interest in the association and helped immeasurably its prestige in the minds of mechanical officials of the railroads. In 1935 the officers of the association aroused sufficient interest and support from railroad officials to hold a successful business meeting. Because of lack of funds this meeting was covered in *Boiler Maker and Plate Fabricator.*

Since then the return to former virility and influence of the association has been rapid. This year almost universal support from the railroads assures one of the most successful meetings since the inception of the Master Boiler Makers' Association.

President Milton

Montague Victor Milton, president of the Master Boiler Makers' Association, is chief boiler inspector of the Central Region of the Canadian National Railways. He was born in London, England, February 24, 1883, and attended the Mechanical Institute, Stratford, London, England. After serving as an apprentice on the Great Eastern Railway of England from March, 1897, to 1904, he went to Peru, South America, as foreman and inspector of the Peruvian Central Railway at Guadalupe and Lima. Leaving Peru in June, 1907, he became leading hand of the marine department of the Great Eastern Railway at Parkeston Quay, England. In 1908 he came to Canada, locating at North Bay, Ontario, as foreman and district inspector of the Canadian Pacific Railway. From June, 1915, to May, 1919, he was general boiler inspector of the Canadian Government Railways at Cochrane, Ont. In May, 1919, he was made boiler inspector of the Canadian National Railways, Western Region, becoming chief boiler inspector of the Central Region at Toronto, Ont., January, 1925, which position he now holds.

Mr. Milton became a member of the Master Boiler Makers' Association in 1925 and immediately demonstrated his interest by taking part in discussions of the various reports. He was drafted for committee service in 1928 and in 1935 was elected a member of the executive board. He is therefore well qualified for the presidency of the association.

Secretary-Treasurer Stiglmeier

Albert Frank Stiglmeier, secretary-treasurer of the Master Boiler Makers' Association, was born at Buffalo, N. Y., December 12, 1886. He received his education in the grammar schools and the International Correspondence Schools. From November, 1901, to November, 1905, he was a boiler maker apprentice in the Buffalo shops of the Delaware, Lackawanna & Western. As a journeyman he served with the following concerns in Buffalo—Tashenberger Brothers Company, Howard Brothers Boiler Works, Oldham Boiler Works, Barber Asphalt Paving Company, and with the New York Central at its Depew, New York, shops. From October, 1906 to 1908 he was journeyman boiler maker in the Buffalo, N. Y., shops of the Delaware, Lackawanna & Western, and then until April, 1912, was layer out and flanger in the same shop. He went with the Erie Railroad at Hornell, N. Y., May, 1912, as assistant boiler foreman, but a few months later, in July, was made general boiler department foreman. In December, 1912, he was made assistant boiler department foreman of the New York Central at its West Albany locomotive shops, succeeding to the position of general boiler department foreman in July, 1917; he remained in that position until April, 1919, when he became general boiler department foreman of the Baltimore & Ohio, at its Mt. Clare, Md., locomotive shops. He returned to the New York Central at its West Albany shops in November, 1923, as

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Car Department Officers' Association

Gray Room, Hotel Sherman

Tuesday, September 28

Morning Session

10:00 o'clock

Address by President K. F. Nystrom, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific.
Address by a representative of the Association of American Railroads.
Address by Roy V. Wright, editor, Railway Mechanical Engineer.
Report of Auditing Committee.
Report of Secretary.
Report on Constitution and By-Laws.
Election of Officers.

Afternoon Session

2:00 o'clock

Address by C. J. Nelson, superintendent interchange, Chicago Car Interchange Bureau.
Address by W. L. Ennis, manager refrigeration and freight claim prevention, Chicago, Milwaukee, St. Paul & Pacific.

Wednesday, September 29

Morning Session

9:30 o'clock

Address by J. T. Gillick, chief operating officer, Chicago, Milwaukee, St. Paul & Pacific.
Address by LeRoy Kramer, vice-president, General American Transportation Corporation.
Address by A. F. Stuebing, railway mechanical engineer, United States Steel Corporation.

Afternoon Session

2:00 o'clock

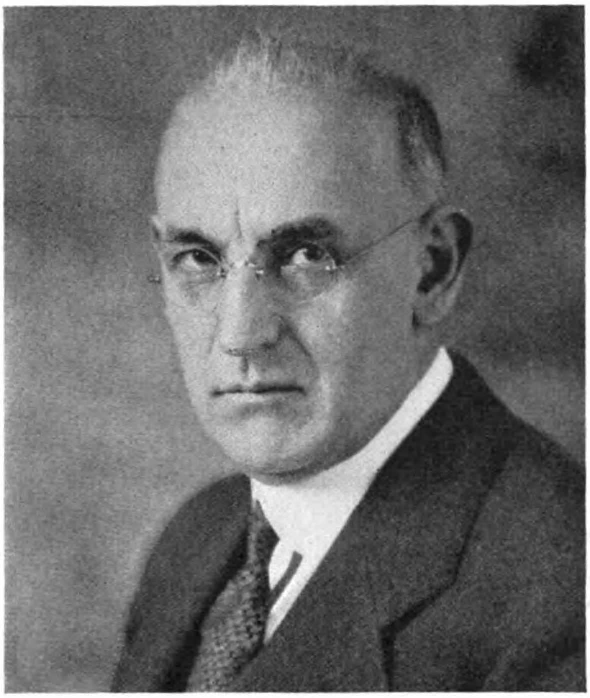
Address by W. J. Patterson, chief, Bureau of Safety, Interstate Commerce Commission.
Discussion of A.A.R. Rules, led by M. E. Fitzgerald, chief car inspector, Chicago & Eastern Illinois.

Car Department Officers

The meeting, which will be held at Chicago September 28 and 29, is first since 1930

E. J. Robertson,
Vice-President

A. J. Krueger,
Vice-President



K. F. Nystrom, President

C. J. Nelson,
Vice-President

THE Car Department Officers' Association will hold a two-day meeting in the Gray Room of the Hotel Sherman, Chicago, on Tuesday and Wednesday, September 28 and 29, 1937.

This association came into being to meet a definite need which was widely felt among car-department officers and particularly among the chief interchange inspectors at the various important interchange points in America. The marked variation in interpretation of the M.C.B. interchange rules led the chief interchange inspectors to consider the advisability of an association, at the meetings of which some sort of agreement on interpretations might be reached. To Hugh Boutet, chief interchange inspector, Cincinnati, Ohio, belongs the credit for taking the initiative. He secured the support of his governing committee at Cincinnati and, on the authority of this committee, called a meeting at Cincinnati in April, 1898, at which seven interchange inspectors were present. The seven men who attended the first meeting were: Charles Waughop, St. Louis, Mo.; John Doyle, Columbus, Ohio; J. C. McCabe, Cleveland, Ohio; William Palmer, Toledo, Ohio; J. W. Baker, Kansas City, Mo.; E. E. Merriss, Lexington, Ky., and Fred Morgan, Chattanooga, Tenn.

Permanent Organization Effected

Following the initial meeting one or two others were held at various points on an informal basis until the Fall of 1899 when, at Cleveland, Ohio, a permanent organization was set up composed of the chief joint car inspectors. The object of the association was to develop uniform and correct interpretation of the interchange rules. Charles Waughop was the first president.

At St. Louis, Mo., in 1904, the constitution was revised to make car foremen eligible to membership, thus widening the influence of the association to include the smaller interchange points as well as the larger ones at which joint inspection bureaus were maintained. Mr. Boutet was elected president at the 1904 meeting and served through 1911. Since then a new president has been elected at each convention.

At the outset the membership was never large; there were scarcely more than ten or twelve members in the organization until after the change in the constitution made in 1904. Then the membership began to climb. In 1911 there were about 200 members and, in 1915, when the next step in broadening the activities of the association took place, there were 382 members.

Scope Broadened

In 1915 a movement was started to increase the scope of the work of the association by providing a place on the program for individual papers. The president that

year, F. H. Hanson of the New York Central, suggested that a group of committees should be set to work on car-department subjects to present reports at the meeting. In actual practice, however, the movement started at that time resulted in individual papers rather than committee reports.

The first effort along this line was a contest for papers on car-department apprenticeship, $50 in prize money being donated by an interested member of the association. A number of good papers were developed in this contest and presented at the 1916 meeting. At that meeting a further broadening of the membership was effected by making car inspectors, M.C.B. bill clerks or any others actively engaged in the work of the car department eligible for membership.

The war intervened to postpone further active work by the Chief Interchange Car Inspectors' and Car Foremen's Association until September, 1919. At that meeting a membership of 508 was recorded. The program was confined strictly to the discussion of the rules, probably because of the lack of time to develop individual papers. In 1920 the membership had dropped back to 349. In 1921 the association held no full convention, but the members attended an open meeting of the executive committee in March to discuss proposed changes in the interchange rules and held a similar one-day meeting early in January of the succeeding year which was confined strictly to a discussion of the rules then going into effect. No association business was transacted.

In November, 1922, a full convention was held, at which, in addition to the usual discussion of the rules, an excellent program of individual papers was presented. For the next four years the association continued to meet regularly each year, with programs of fine quality, including papers on a wide range of car department problems.

At the meeting in September, 1926, it was decided to change the name of the association to the Railway Car Department Officers' Association, with the object of encouraging and prompting car-department supervisory officers of all ranks to become members of the association. At the time of this meeting the total membership was 1,300.

Rival Springs Up

In the meantime, a new regional organization of car-department supervisors had sprung up in the Southwest. This was known as the Southwestern Master Car Builders' and Supervisors' Association, which headed up in and around St. Louis and made an aggressive play for the support of the car-department officers throughout the Southwest. Following the 1926 meeting of the Railway Car Department Officers' Association a strong movement for merging the two associations got under way and negotiations were carried through to a satisfactory conclusion in time to call a general convention of the two organizations in 1928, at which plans for consolidation were placed before their respective memberships. These plans were approved and the merged organization named the "Master Car Builders' and Supervisors' Association."

The membership of this organization comprised master car builders and all car-department men employed in a supervisory capacity. Its membership was, therefore, somewhat restricted from that of the Car Inspectors' and Car Foremen's Association which, in 1916, removed all restrictions except employment in the car department. The purpose of the new organization was "to promote more efficient maintenance and use of cars by the discussion of interchange rules and all branches of car-department work not now given detailed consideration by the Mechanical Division of the American Railway Association." This association held two conventions after the reorganization—one in 1929 and one in 1930, at which time the name was changed to "Car Department Officers' Association." At that meeting the officers now in charge of the association were elected and no meeting has since been held owing to the depression.

The character of the program since the reorganization has not greatly changed. Some attempt was made, however, to systematize the handling of questions concerning the interpretation of the interchange rules by referring them to committees. The old practice of open discussion of the new rules was continued.

Membership Requirements

The history of this association records a movement tending toward the removal of restrictions to membership which ultimately placed no restrictions whatever on any class of car-department employees who wished to join. The movement which resulted in the change in the name of the association in 1926 to Railway Car Department Officers' Association and the development in the Southwest of a rival association at about the same time are both indications that the association had gone too far in letting down the bars. The result was a lack of interest on the part of the responsible car-department officers so that the membership of the association was largely drawn from the chief interchange car inspectors, other car inspectors, M.C.B. bill clerks, and other minor supervisors and employees. With its present membership requirements this association has an opportunity to deal effectively with many car-department problems which are not dealt with now and are not ever likely to be dealt with by the Mechanical Division. There is no less need for the association now than when it was organized. It simplifies the work of the Arbitration Committee and has the field of car-department-supervision problems all to itself.

President Nystrom

K. F. Nystrom, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific, was born in Sweden in September, 1881, and was educated in that country, graduating from the university in 1904 as a mechanical engineer. Coming to this country he was a draftsman with the Pressed Steel Car Company from 1905 to 1909. He was on the engineering staff of the Pullman Company for a short time, after which he entered the car design department of the Southern Pacific in 1909. In 1911 he was made assistant mechanical engineer for the American Car & Foundry Company, leaving that position in 1912 to become mechanical engineer of the Acme Supply Company. From 1913 to 1918 he was chief draftsman of the car department of the Grand Trunk, and then for two years was chief draftsman, car department, Canadian Pacific. He returned to the Grand Trunk in 1920 as engineer car construction, leaving that company in 1922 to become engineer car design, Chicago, Milwaukee, St. Paul & Pacific. From 1925 to 1927 he was engineer of motive power and rolling stock of that road, and then in July, 1927, became master car builder, being advanced in September of the same year to superintendent of the car department.

Prior to taking his present position in 1927 Mr. Nystrom was largely concerned with problems of equipment design. He has since demonstrated also a marked capacity in an administrative position as a leader of men. He is aggressive, progressive, and has contributed possibly as much as any one other railroad official to the art of building railway equipment, using carbon or low alloy steels, by the welding process, without sacrifice of

(*Continued on page 404*)

General Foremen's Association

Lost out on only three annual meetings during depression—Meets in Chicago Sept. 28-29

F. B. Downey,
First Vice-President

J. W. Oxley,
Second Vice-President

C. C. Kirkhuff,
Third Vice-President

W. F. Hall,
Secretary-Treasurer

F. T. James, President

THE International Railway General Foremen's Association will hold its annual convention in the Rose Room, Hotel Sherman, Chicago, on Tuesday and Wednesday, September 28-29, 1937.

While this association did not attempt to hold meetings in 1931, 1932 and 1933, it did hold two-day sessions in 1934, 1935 and 1936. President A. H. Keys, who was elected at the 1930 meeting, functioned over this period, being succeeded at the convention a year ago by F. T. James. William Hall, the secretary-treasurer of the organization, gave much time and energy to the interests of the association during the depression years, and while the two-day sessions in the past three years have not been largely attended, a nucleus of the membership has continued to function quite actively, all things considered. Unfortunately, because of failing health, Mr. Hall was forced to retire from the work of the association last spring, and no successor has as yet been selected. President James and his associates in office, however, in spite of this handicap, have built up a strong, constructive program for the coming convention.

In order better to understand the importance of this organization it may be well briefly to review its history and objectives.

While attending a railway convention in Indianapolis in 1904 a shop foreman from Shreveport, La., approached E. C. Cook, then managing editor of the Railway Journal, asking him to aid in establishing an association for enginehouse foremen. After seeking the advice of a number of shop foremen and representatives of various railway supply companies, Mr. Cook laid the foundation for establishing the I.R.G.F.A., enlarging the scope of the organization to include all shop superintendents and all general foremen, including assistants. Having decided on this course, he published articles in the Railway Journal suggesting the plan and immediately obtained many enthusiastic responses. About 100 foremen endorsed the plan and became charter members.

As a result a meeting was held at St. Louis, Mo., on September 7, 8 and 9, 1905. By the time it adjourned the charter membership list had grown to 225 members covering nearly every railroad in the United States and some in Canada. A constitution and by-laws were adopted, which incorporated the name of the association as it is today, with a view of including in its membership all railway shop foremen not allied with other mechanical associations, and especially general foremen, shop superintendents, enginehouse foremen, division foremen, district foremen, machine-shop foremen and their assistants.

The first officers of the association were: President, W. H. Graves, general foreman, C. & A. Ry., Roodhouse, Ill.; first vice-president, C. A. Swan, Jr., C. & A., Roodhouse, Ill.; second vice-president, E. F. Fay, general foreman, Union Pacific, Cheyenne, Wyo.; third

International Railway General Foremen's Association

Rose Room, Hotel Sherman

Tuesday, September 28

Morning Session

9:30 o'clock

Opening Ceremonies.

Opening Address. How Can the Mechanical Supervisor be of Greater Assistance to the Railroad Management, by R. E. Woodruff, vice-president, Erie Railroad.

How Long Can We Put Off Training Men—Locomotive and Car Department Mechanics—Supervisors, by H. J. Schulthess, chief of personnel, Denver & Rio Grande Western.

Discussion.

Afternoon Session

2:00 o'clock

Mechanical Supervisors and Public Opinion, by Roy V. Wright, editor, Railway Mechanical Engineer.

Modern Methods in Freight Car Building and Repair, by J. E. Echols, foreman freight car repair shop, Norfolk & Western.

Freight Car Repairs at Keyser Valley, D. L. & W. Railroad, by J. Thompson, general foreman, car department, Delaware, Lackawanna & Western.

Discussion.

Wednesday, September 29

Morning Session

9:00 o'clock

Open Forum. A three-hour roundtable discussion of subjects presented by members pertinent to locomotive back shop, enginehouse and passenger and freight car problems.

What to Teach About Safety.
Improving Work Methods.
Controlling Wastes.
Does Low Stock Inventory Pay.
Winning Co-operation.
Material Reclamation.
Maintenance of Special Equipment Applied to Locomotives.
Maintenance of Freight Equipment.
Care and Maintenance of Shop Tools.
Need for Trained Mechanics, Touching on Apprentices.

Afternoon Session

2:00 o'clock

Can Modern Machine Tools Cut Repair Costs, by L. H. Scheifele, tool and material inspector, Reading Company.

Handling Unsafe Practices About Locomotive and Car Shops, Enginehouses and Repair Yards, by R. C. Helwig, safety agent, Delaware & Hudson.

Discussion.

vice-president, Lee R. Laisure, assistant general foreman, Erie, Hornellsville, N. Y.; fourth vice-president, W. E. Farrell, enginehouse foreman, Big Four Ry., Delaware, O.; secretary-treasurer, E. C. Cook, managing editor, Railway Journal, St. Louis, Mo. William Hall, recently retired secretary, was one of the charter members of the association.

Quoting from the constitution: "The objects of this Association shall be the mutual improvement of its members by exchanging ideas by means of annual meetings and the reading and the discussion of papers; the general exchange of views along lines pertaining to railway locomotive shop practices, so that we may all profit by the experience of others in our line of railway work and also be of greater value to the companies employing us, and to those for whose interest we labor." This section still stands as it did 32 years ago.

In the early meetings of the association the subjects discussed included repair methods and controversial subjects such as electricity versus steam power, electricity versus oil for headlights, and the advisability of cooling locomotives. Later they included design, operation and organization of enginehouses and shops, with continued attention being given to methods and equipment for improving shop efficiency.

At the 1911 annual meeting committee reports were submitted on the promotion of shop efficiency, shop organization, development of personnel, and specialization and standardization of work. A committee on railway shop kinks and the value of such devices reported that an elaborate illustrated book on "Railway Shop Kinks" had been compiled under the supervision of the committee by the mechanical department editor of the Railway Age Gazette; it was composed largely of a great number of shop kinks published during the previous two years in the Mechanical Edition of the Railway Age Gazette (now the *Railway Mechanical Engineer.*)

For several years the trend of discussion was the same as that at the 1911 meeting, but with the scope becoming broader and broader, thereby making the foreman's outlook on these subjects relatively more important to himself and to the railroad, and crystallizing the foreman's point of view of his work in relation to general shop problems.

In 1930 the twenty-fifth annual meeting of the association was held at the Hotel Sherman, Chicago, September 16 to 19, inclusive, with a total registration of 365. Reports presented at this convention included such subjects as engine-truck maintenance and lubrication; cost of material delays to locomotives and cars; stabilization of mechanical shop forces; inspection, maintenance and repairs to gas-electric rail cars; general foremen's contribution to fuel economy; and better maintenance of passenger-car equipment. These subjects indicate further the general trend of the problems discussed by the General Foremen's Association as the years progressed. Subjects apropos of modern railway development, including maintenance of Diesel locomotives, production methods in locomotive repairs, and maintenance of high-speed passenger equipment also have been discussed.

As indicated at the beginning of this article, the association did not attempt to hold conventions in 1931, 1932 and 1933, although its officers, and particularly its secretary-treasurer, William Hall, were ever on the alert to resume activities the moment conditions would permit. Two-day meetings were held in Chicago during September of 1934, 1935 and 1936. The attendance was, of course, subnormal, but interest in association activities was maintained at a fairly high point, considering the conditions under which the organization was attempting to operate.

From the earliest meetings when subjects were more or less devoted to immediate shop problems involving maintenance methods to later meetings when subjects involved the relation of shop organization, production methods and development of personnel for the purpose of improving motive-power and rolling-stock as well as general transportation efficiency, the purpose of the Association has always been the interchange of ideas pertaining to better maintenance and production methods, organization and personnel, thereby benefiting the railway industry as a whole.

President James

Frederick T. James is general foreman, motive power, of the Delaware, Lackawanna & Western Railroad at Kingsland, N. J. He was born at Buffalo, N. Y., March 16, 1894. He worked at various occupations while attending grammer school and the first year of high school, and became a machinist apprentice at Farrar & Trefts Machine & Boiler Works, Buffalo, in July, 1908; he has, however, continued his educational training more or less continually ever since. This included courses in civil service and government at Bryant & Stratton Business College, Buffalo; and machine-shop practices and automobile mechanics at the Buffalo Y.M.C.A. He has acted as chairman of foremanship courses at Hoboken, N. J., under the New Jersey State Vocational Education Department, and has taken lectures and discussions in shop employee psychology at the State Normal School at Montclair, N. J. He also took a special electrical course at the Paterson, N. J., Vocational School prior to the electrification of the metropolitan suburban section of the Lackawanna.

In September, 1909, he became a roundhouse utility worker at East Buffalo, on the Lackawanna. For some months in 1911 he was assigned to the master mechanic's office, in connection with the compilation of special locomotive performance reports, later being promoted to coal chute foreman at East Buffalo roundhouse, and then acting as a machinist at the East Buffalo locomotive shop. He was made general foreman at Groveland, N. Y., in October, 1915, and erecting-shop foreman at East Buffalo, February, 1918, and filled various positions until he was assigned in February, 1923, as special locomotive and boiler inspector on the Buffalo division. On November 1, 1923, he was transferred to Binghamton as day roundhouse foreman, and on February 18, 1924, was promoted to general foreman at the Kingsland, N. J., locomotive shop. Since he has been in charge at that point a shop has been developed for handling the electrical equipment and much of the work previously done at the Dover, N. J., frog and switch shop has also been transferred to Kingsland.

He was secretary of the Lackawanna Foremen's Association at East Buffalo from 1918 to 1922, and was First Lieutenant, Engineers, 491st Division, Reserve Officers, from 1925 to 1935. He was elected president of the International Railway General Foremen's Association, September, 1936.

Mr. James is of a quiet and reserved nature and in coming to a decision insists on having all of the pertinent facts in a case clearly before him. Maintaining an open mind and thorough-going to the core, he has made an excellent record as a supervisor and also in the promotion of safety. A keen student of the basic principles of supervision and of the technique of dealing with workers, he has been unusually successful as a foreman. His ability to adjust himself successfully to radically changed conditions was clearly demonstrated when the metropolitan suburban section of the Lackawanna was elec-

(*Continued on page 404*)

Allied Railway Supply Exhibit

Will exceed the previous Chicago shows in the variety of products and importance of improvements

E. S. FitzSimmons, President

L. B. Rhodes,
First Vice-President

J. W. Fogg,
Second Vice-President

C. F. Weil,
Third Vice-President

F. W. Venton,
Fourth Vice-President

IN pre-depression days the Hotel Sherman, Chicago, was a beehive of activity both during the well-attended annual spring conventions of railway fuel men and during the equally well-attended fall conventions of the traveling engineers. No small part of the interest in these conventions centered about the accompanying exhibitions of railway mechanical equipment and supplies. There were exhibits also at the meetings of the various mechanical department associations that met during the year at Chicago, or elsewhere. It is highly gratifying to note that the exhibits to be shown this year by the Allied Railway Supply Association, in conjunction with the joint mechanical association meetings at the Sherman, September 28 to October 1, promise to exceed in

M. K. Tate,
Fifth Vice-President

H. S. Mann,
Sixth Vice-President

J. E. Gettrust,
Secretary

G. R. Boyce,
Treasurer

variety of products displayed and especially in the important character of the many improvements demonstrated any previous show of railway mechanical equipment and supplies held in Chicago.

As a matter of fact, the actual number of exhibitors this year, as this issue goes to press is only 96 companies whereas 126 companies exhibited in 1929, and 125 companies in 1930, the last year when a railway exhibit was provided at any of the fall meetings. The same amount of floor space is utilized, however, namely, about 14,000 sq. ft., in the main exhibition hall, club room, and mezzanine floor of the hotel. Of this area, a total of 10,836 sq. ft. of actual display space will be utilized, consisting of 263 numbered spaces, each 6 ft. square, and 4 sections, A, B, C, and D, aggregating 38 spaces more, or making a total of 301 spaces.

Practically all of this exhibition space will be fully occupied and almost every type of railway mechanical equipment and supplies will be on display, ranging from boiler compounds to lock nuts, and from equipment specialties to the latest improved materials and tools. It is probably conservative to say that improvements effected in these new materials, devices and tools, as a result of intensive research and development since the last exhibit was held in 1930, exceed the improvements which it was possible to show at any previous convention. Railway mechanical supervisors will find this exhibition both highly interesting and informative and a potent reason to advance to their respective managements in asking permission to attend the association meetings.

What The Allied Railway Supply Association Is

Over a considerable period of years, but culminating during the depression, the sentiment of responsible railway and supply company officers pointed to the urgent need for reducing the number of specialized mechanical association meetings, either through amalgamation, or the holding of joint meetings at the same time and place, without loss of individual association identity. This would permit a single exhibit to replace six or seven exhibits held in as many weeks at different times throughout the year, with proportionately greater expense both to railways and supply companies. The coordination of railway association activities has been, and is still being, studied by a special committee of the Mechanical Division, consisting of John Purcell, Santa Fe; E. B. Hall, North Western, and F. R. Mays, Illinois Central. Much of the detailed work in conjunction with co-ordination studies, and especially the arrangement for the present joint meetings, has been done by F. P. Roesch, Standard Stoker Company, and T. Duff Smith, secretary, Railway Fuel & Traveling Engineers' Association.

For the supply interests, the possible advantages of a single exhibit were first recognized quite a number of years ago by such men as F. N. Bard, Barco Manufacturing Company; Irving H. Jones, Cleveland, Ohio; J. W. Fogg, MacLean-Fogg Lock Nut Company; F. W. Venton, Crane Company; G. R. Boyce, A. M. Castle & Company; C. M. Hoffman, Dearborn Chemical Company; J. J. Cizek, Leslie Company, and Joseph Sinkler, Chicago. Through the effective work of these men, ably supplemented by other supply company representatives, the Allied Railway Supply Association, Inc., was organized at Chicago on May 4, 1931, thus combining in one association the supply groups affiliated with the following seven railroad associations: Traveling Engineers' Association, Air Brake Association, International Railway General Foremen's Association, Master Boiler Makers' Association, International Railway Fuel Association, Railroad Master Blacksmiths' Association, and the Car Department Officers' Association.

The finances of these various supply groups were pooled; their respective presidents became vice-presidents of the new association; their secretaries became members of the executive committee, and Irving H. Jones was elected first president. The present officers of the association to whom credit must go for the notably constructive exhibit which will be held at the Hotel Sherman, Chicago, during the latter part of this month, are as follows: President, E. S. FitzSimmons, Flannery Bolt Company, Bridgeville, Pa.; first vice-president, L. B. Rhodes, Vapor Car Heating Company, Washington, D. C.; second vice-president, J. W. Fogg, MacLean-Fogg Lock Nut Company, Chicago; third vice-president, C. F. Weil, American Brake Shoe & Foundry Company, Chicago; fourth vice-president and assistant treasurer, F. W. Venton, Crane Company, Chicago; fifth vice-president, M. K. Tate, Lima Locomotive Works, Inc., Lima, Ohio; sixth vice-president, H. S. Mann, Standard Stoker Company, Inc., Chicago; secretary, J. F. Gettrust, Ashton Valve Company, Chicago; treasurer, G. R. Boyce, A. M. Castle & Company, Chicago.

The work involved in getting up an exhibition of this kind is quite staggering in the amount of detail involved, and it was highly essential, therefore, to divide the task among as many men as practicable. In addition to the officers of the association, four committees, comprising a total of 47 men, have participated in the preparatory work of getting ready for this convention and exhibition.

Registration Committee

The registration committee, under the direction of Chairman R. T. Peabody will assist the various associations in registering their respective members as they arrive.

R. T. Peabody, chairman, Air Reduction Sales Co., New York
Dan Hall, Hunt-Spiller Mfg. Corp., South Boston, Mass.
Roger Q. Milnes, Dearborn Chemical Co., Chicago
E. H. Weaver, Westinghouse Air Brake Co., Cleveland, Ohio
H. E. McCandless, Simmons-Boardman Publishing Corp., New York
William Jones, Oxweld Railroad Service Co., Chicago
C. M. Rogers, Locomotive Firebox Co., Chicago
R. H. Jenkins, Nathan Mfg. Co., Roanoke, Va.
J. J. Clifford, Wilson Engineering Corp., Chicago
P. R. Austin, Johns-Manville Co., Chicago
G. W. Taylor, Locomotive Finished Material Co., Atchison, Kan.
R. K. Smith, J. S. Coffin, Jr., Co., Joliet, Ill.
J. L. Bacon, Valve Pilot Corp., New York

Reception Committee

The reception committee, headed by Chairman Richard Welsh, includes the following members:

Richard Welsh, chairman, Nathan Manufacturing Co., Chicago
R. A. Carr, Dearborn Chemical Co., Chicago
E. J. Collins, Oxweld Railroad Service Co., Chicago
E. J. Reardon, Locomotive Firebox Co., Chicago

Hotel Committee

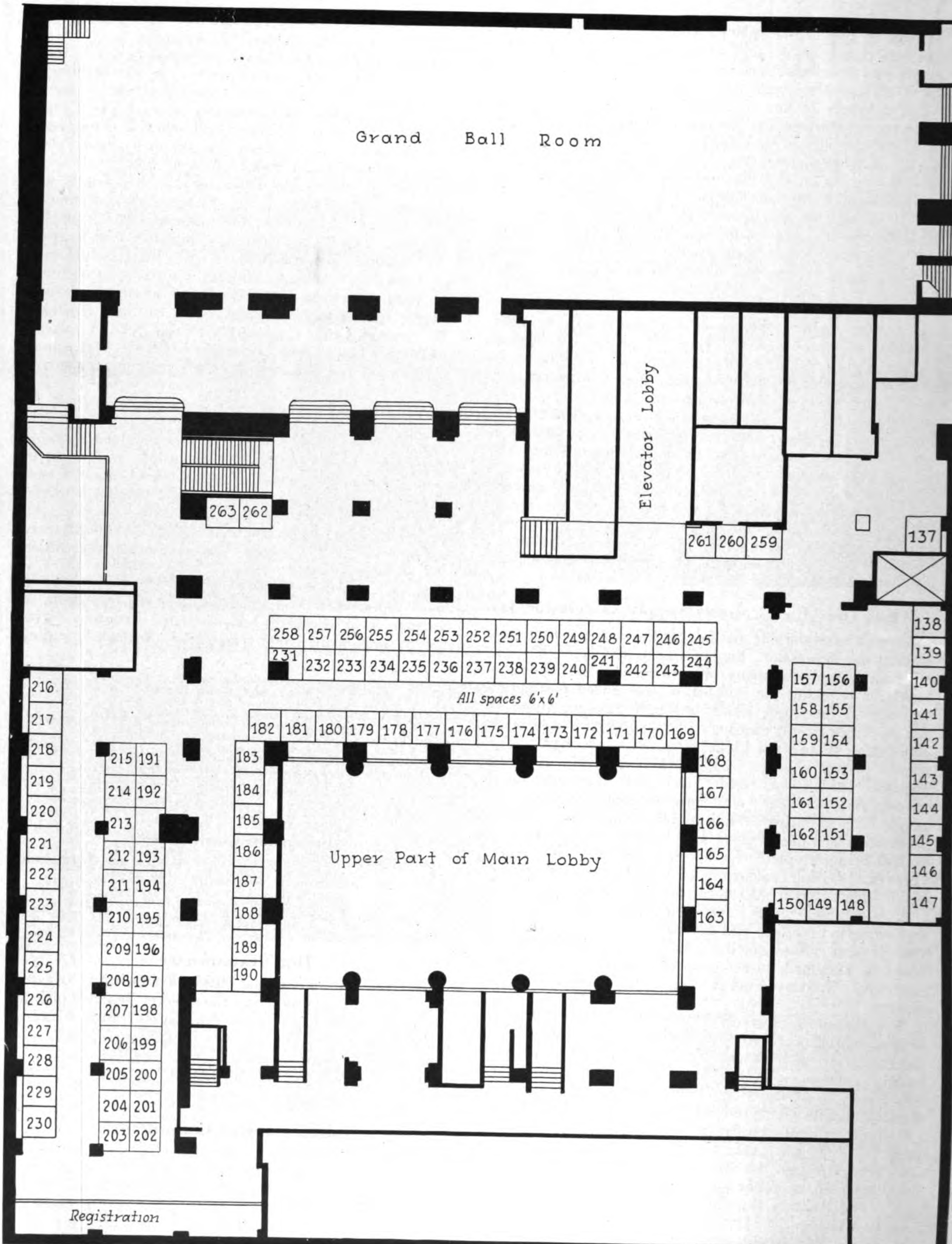
The hotel committee, the duties of which are to assist convention attendants with their hotel reservations, is under the leadership of Chairman Joseph Sinkler and is made up as follows:

Joseph Sinkler, chairman, Joseph Sinkler, Inc., Chicago
C. W. Sullivan, Markham Supply Co., Chicago
John Ash, Edna Brass Mfg. Co., Cincinnati, Ohio
John E. Long, Franklin Railway Supply Co., Chicago
R. N. Sinkler, Corley Company, Jersey City, N. J.

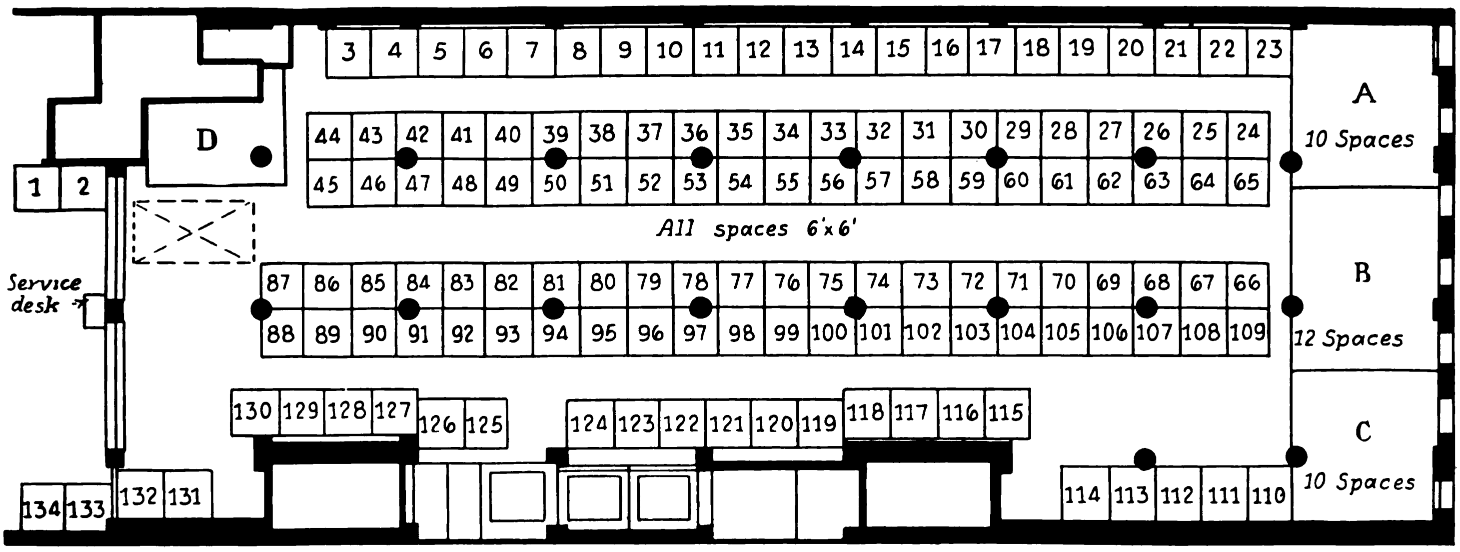
Entertainment Committee

An important, if non-technical, feature of the convention is the entertainment, arrangements for which have been made by the entertainment committee, headed by Chairman J. W. Fogg and Vice-Chairman Bradley S. Johnson. It includes the following members:

J. W. Fogg, chairman, MacLean-Fogg Lock Nut Co., Chicago
B. S. Johnson, vice-chairman, W. H. Miner, Inc., Chicago
John Baker, Locomotive Firebox Co., Chicago
R. A. Carr, Jr., Dearborn Chemical Co., Chicago
E. E. Thulin, Duff-Norton Mfg. Co., Chicago
M. K. Tate, Lima Locomotive Works, Inc., Lima, Ohio



Arrangement of exhibit spaces in Hotel Sherman



Arrangement of exhibit space in the main exhibition hall

E. J. Fuller, Hunt-Spiller Mfg. Corp., South Boston, Mass.
Howard W. Dillon, Paxton Mitchell Co., Omaha, Neb.
Richard Welsh, Nathan Mfg. Co., Chicago
E. H. Weaver, Westinghouse Air Brake Co., Cleveland, Ohio
Carl A. Millar, Clinch & Co., Chicago
C. F. Weil, American Brake Shoe & Foundry Co., Chicago
L. A. Rowe, MacLean-Fogg Lock Nut Co., Chicago
T. O'Leary, Jr., Johns-Manville Sales Corp., Chicago
Geo. E. Haas, Pyle-National Co., Chicago
Tom R. King, O. K. Co., Chicago
Wm. Leighton, Oxweld Railroad Service Co., Chicago
Henry S. Mann, Standard Stoker Co., Inc., Chicago
Bard Browne, Superheater Co., New York
L. B. Rhodes, Jr., Vapor Car Heating Co., Inc., Washington, D. C.
C. O. Jenista, Barco Manufacturing Co., Chicago
F. W. Venton, Crane Co., Chicago
T. Duff Smith, Railway Fuel & Traveling Engrs'. Assn., Chicago
E. L. Woodward, Railway Mechanical Engineer, Chicago
H. A. Morrison, Railway Age, Chicago

President FitzSimmons

E. S. FitzSimmons, vice-president of the Flannery Bolt Company, has for many years been active in the Boiler Makers Supply Men's Association, which has been associated with the Master Boiler Makers' Association, becoming president of the Allied Railway Supply Association last year.

He was born at Columbus, Ohio, April 12, 1876, and was educated in the grammar and high schools of Horton, Kan., and in the International Correspondence Schools. After serving as apprentice and journey mechanic with the Chicago, Rock Island & Pacific at Horton, Kan., he left that company in May, 1899, to become foreman boiler maker on the Delaware, Lackawanna & Western at Scranton, Pa. From August, 1904, to April, 1905, he was general boiler inspector of the New York, New Haven & Hartford, and then until August, 1907, was general master boiler maker of the Erie System. He then became master mechanic on the Erie at Galion, Ohio, and in February, 1908, was transferred in the same capacity to Hornell, N. Y. In January, 1912, he was promoted to mechanical superintendent of the Erie Lines West, being transferred in September, 1914, to mechanical superintendent of the Erie Lines East, with headquarters at New York, resigning in May, 1918, to become works manager of the McCord Manufacturing Company, Detroit, Mich. He became western manager of the Wilson Welder & Metals Company, Chicago, in April, 1919, leaving that position at the end of the year. He became associated with the Flannery Bolt Company as service engineer in January, 1920. He was made sales manager of the same company in 1922, and vice-president in February, 1936.

Mr. FitzSimmons, while foreman boiler maker of the D. L. & W. at Scranton, became a member of the original Master Steam Boiler Makers' Association at its charter meeting in October, 1903. Being extremely active in the work of this organization he was elected a first vice-president in 1905, and with other officers of that and the sister organization—the International Railway Master Boiler Makers' Association—worked indefatigably for the union of the two groups. This was accomplished in 1907 and Mr. FitzSimmons became first vice-president of the new International Master Boiler Makers' Association. His activities were soon transferred to the supply field and he became equally interested in the success of the Master Boiler Makers Supply Men's Association which had been formed in 1905.

Secretary Gettrust

Joseph F. Gettrust, secretary of the Allied Railway Supply Association, is a native of Baltimore, Md., and was educated in the public schools of that city. He has been employed by the Cincinnati, Indianapolis, St. Louis & Chicago (now the C. C. C. & St. L.), the Ohio & Mississippi Railroad (now the Baltimore & Ohio), the Galena Oil Company, and is now representative of the Ashton Valve Company at Chicago. He is a past president of the Air Brake Appliance Association and also of the Railway Equipment Association. As secretary of the Allied Railway Supply Association he has been one of a small coterie of men who have labored unceasingly and most effectively during recent months for a successful exhibit. He is familiarly known in the railroad field as "Joe." His principal avocation is salt water fishing in the pleasant waters off the Florida coast.

The Exhibit

The list of exhibitors, with the products which they will show, and the names of representatives in attendance, follows:

Air Reduction Sales Company, New York. Spaces 224, 225 and 226.

Alfol Insulation Company, Inc., New York.—Alfol panel insulation for refrigerator cars; Alfol jacket insulation for refrigerator cars; Alfol insulation for locomotive boilers; Alfol insulation for passenger, dining, baggage, mail and tank cars. Represented by D. D. Grassick, L. T. Sibley and John E. P. Morgan.

American Arch Company, Inc., New York.—Security locomotive arch brick; Security circulator; suspended arches and side walls for boiler plants, furnaces, etc. Represented by B. A. Clements, George A. Price, I. D. Brandon, S. MacClurkan, J. P. Neff, A. F. Becker, Thomas Mahar, G. M. Bean, T. M. Ferguson, William Haag, T. F. Kilcoyne, E. T. Mulcahy, W. E. Salisbury, M. R. Smith and A. M. Sucese. Spaces 79, 80, 81, 94, 95 and 96.

American Brake Shoe & Foundry Company, New York.—Member of Allied Railway Supply Association, but not exhibiting.

American Locomotive Company, New York.—Alco reverse gear; Alco staybolts; lateral cushioning device; springs; Universal spring plates; E-Z-On journal box lids; forgings; rods; valve gear parts; Diesel

parts. Represented by N. C. Naylor, W. S. Morris, W. A. Callison and W. F. Lewis. Spaces 26, 27, 28, 29, 60, 61, 62 and 63.

American Steel Foundries, Chicago. — Models of Simplex high-speed freight car trucks and Spring-plankless self-aligning freight car trucks; models of roller bearing units for passenger cars and locomotives; hardened and ground pins and bushings. Represented by F. H. Bassett, R. W. Clyne, S. M. Goodrich and F. H. Norton. Space 56.

American Throttle Company, Inc., New York. — See The Superheater Company.

Apex Tool & Cutter Company, Inc., The, Shelton, Conn.—Inserted forged tools for roughing and finishing tires and wheels; tools for journals and wheel seats of axles; adjustable tools for wheel centers; tools for lathes, shapers, planers and boring mills; standard tools for Morton draw-cut shaper. Represented by F. J. Wilson and H. M. Sheridan. Space 150.

Arrow Tools, Inc., Chicago.—Small forged tools, including chisels, beading tools, back out punches, etc.; safety tool retainers for pneumatic riveting and chipping hammers. Represented by N. W. Benedict and H. J. Trueblood. Space 242.

Ashton Valve Company, The, Boston (Cambridge), Mass.—Locomotive muffled and open pop safety valves; dustproof, illuminated double dial locomotive steam and quadruplex air brake gages; back pressure gages; single and duplex air brake gages; test gages; dead-weight gage testers; wheel press recording gages and attachments; locomotive driving wheel quartering gages; protected dial gages; inspectors' testing and proving outfits. Represented by J. F. Gettrust, John Welsh and Charles Gaston. Spaces 10 and 11.

Barco Manufacturing Company, Chicago.—Barco flexible joints; Barco all-metal steam, air, oil and water connections between locomotive and tender; Barco all-metal steam heat connections between cars and for rear of tenders; Barco float type low water alarms; Barco power reverse gears; Barco automatic smoke box blower fittings. Represented by F. N. Bard, C. L. Mellor, W. J. Behlke, F. B. Nugent, J. L. McLean, W. T. Jones, C. C. Cox, N. B. Robbins, L. J. Lytle and C. E. Allen. Spaces 66, 67, 108 and 109.

Barrett-Christie Company, Chicago.—Wells band saw; Delta files; Coffing chain hoists. Represented by Harry Barrett, R. P. Kemp, J. K. Adams, Bob Christie, George F. Hornberger, C. E. Millard, Orin E. Ash, H. N. Hayes and J. R. Coffing. Spaces 254, 255, 256 and 257.

Bird-Archer Company, The, New York. — Proportionate wayside water treatment equipment, including M.A., mechanically agitated proportioning unit; HA, hydraulically agitated proportioning unit, BP, briquette proportioning unit; and various combinations of briquetted, power and liquid chemicals. Represented by C. A. Bird, L. G. Calder, H. C. Harragin, A. C. Melville, H. C. Hutton, J. B. Davis, E. Ruggles and S. P. Foster. Spaces 239, 240, 241, 248, 249 and 250.

Brewster Company, Morris B., Chicago.—See T-Z Railway Equipment Company.

Brubaker & Bros. Company, W. L., Millersburg, Pa.—Taps; dies; reamers. Represented by W. Searls Rose. Space 120.

Burden Iron Company, Troy, N. Y.—Staybolt iron; engine bolt iron; Trojan iron. Represented by J. C. Kuhns, and H. T. Henry. Space 227.

Cardwell Corporation, The, Peoria, Ill.—Space 247.

Champion Brake Corporation, Chicago.—Champion hand brake. Represented by R. K. Ashton, J. M. Allen, R. Bergendahl and E. E. Van Cleave. Space 215.

Cleveland Steel Tool Company, The, Cleveland, Ohio.—Punches; dies; rivet sets; pneumatic and hand chisels; punch and die holders; Lacerda boiler tools. Represented by Harry W. Leighton, Ralph J. Venning and H. A. Lacerda. Space 258.

Coffin, Jr., Company, The J. S., Englewood, N. J.—Coffin feedwater heater system, showing recent improvements in design and application; locomotive Superdraft. Space D.

Corley Company, The, Jersey City, N. J.—Corley A.A.R. "OK-tagonal" pipe unions and combination union fittings. Represented by Ralph A. Corley and Robert N. Sinkler. Spaces 118 and 119.

Crane Company, Chicago.—Crane A.A.R. valves, unions, union-fittings and fittings; high-pressure specialties including locomotive blow-off and pop safety valves. Represented by Fred W. Venton and J. H. Gibson. Spaces 216, 217 and 218.

Dampney Company of America, The, Hyde Park, Boston, Mass.—Apexior surfaced boiler plate and boiler tube steel; glass boilers showing Apexiorized and bare metal flues in steaming operation. Represented by C. J. Hunter, J. D. Bird and C. M. Boling. Spaces 191 and 192.

Dearborn Chemical Company and Electro-Chemical Engineering Company, Chicago—Feedwater treatment chemicals; automatic proportioning wayside treatment equipment; Dearborn automatic constant blow-off; signal foam-meter electromatic blow-off; No-Ox-Id rust preventives. Represented by George R. Carr, R. A. Carr, F. B. Horstmann, S. C. Johnson, R. Q. Milnes, L. O. Gunderson, C. M. Hoffman, H. B. Crocker, C. C. Rausch, L. O. Brown, R. A. Dalton, J. W. Nutting, R. L. Oliver, B. H. Stone, F. R. Liggett, W. H. Hinsch, Don Bodishbaugh, R. J. Maginn and F. J. Boatright. Space C.

Detroit Lubricator Company, Detroit, Mich.—Locomotive mechancial lubricators; Bulls-eye hydrostatic locomotive lubricators; automatic flange oilers; "Genuine Detroit" oil feed dividers; automatic oil reducer; flange oiler feed shoe; "Genuine Detroit" air conditioning controls and accessories. Represented by C. C. King, C. E. Sperry, E. F. Milbank and J. F. Page. Spaces 138, 139, 140 and 141.

Dri-Steam Valve Sales Corporation, New York.—D. S. locomotive separator; D.S. dome throttle valve with separator; D.S. dome throttle valve without separator; D.S. front end throttle valve; D.S. locomotive auxiliary separator; D. S. boiler drum separator and pipe line separator. Represented by A. DeChiara, I. D. Toner, W. D. Scott and C. T. Schreiber. Spaces 12 and 13.

Duff-Norton Manufacturing Company, The, Pittsburgh, Pa.—Lifting jacks of all types; rotary air-motor power jacks; ball bearing, self-lowering governor controlled jacks; ball bearing standard speed jacks; ball bearing journal jacks, 10 to 50 tons capacity; ball bearing empty freight car jacks; self-lowering bridge and wrecking jacks; automatic lowering jacks up to 20 tons capacity; trip or track jacks; telescope screw jacks; jacks for pulling and pushing. Represented by C. N. Thulin and E. E. Thulin. Spaces 133 and 134.

Edna Brass Manufacturing Company, The, Cincinnati, Ohio.—Locomotive appliances. Represented by John T. Ash, H. A. Glenn and William Beck. Spaces 121 and 122.

Electro-Chemical Engineering Corporation, Chicago.—See Dearborn Chemical Company.

Ewald Iron Company, Louisville, Ky.—Samples of staybolt iron and engine bolt iron. Represented by W. R. Walsh. Space 214.

Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio.—Hollow and solid staybolt iron bars; hollow and solid finished staybolts. Represented by E. J. Raub, G. K. Maischaider and J. T. Doyle. Spaces 127 and 128.

Flannery Bolt Company, Bridgeville, Pa.—Locomotive boiler staybolts; installation tools; inspection instruments. Represented by W. T. Kilborn, E. S. FitzSimmons, William M. Wilson and William C. Masters. Spaces, 110, 111, 112, 113 and 114.

Franklin Railway Supply Company, Inc., New York.—Franklin type E power reverse gear; Precision type F-1 power reverse gear; Franklin type E-2 radial buffer; Franklin sleeve joint; McLaughlin joint; Franklin compensator and snubber; Franklin car connection; booster throttle valve; booster roller bearing idler gear; booster cylinder cock control type S, booster slip control valve; booster inlet check valve. Represented by W. H. Winterrowd, W. T. Lane, J. E. Long, and D. I. Packard. Spaces 73, 74, 75, 76, 77, 78, 98, 99, 100, 101 and 102.

Garlock Packing Company, The, Palmyra, N. Y.—Mechanical packings for railway equipment. Represented by R. J. Hinkle, H. J. Ramshaw and R. W. Chambers. Spaces 166, 167 and 168.

Gilg, Henry F., Pittsburgh, Pa.—Dunkirk staybolt steel samples made by the Ludlum Steel Company; Gilg valve for boiler washing and filling, steam, oil and gasoline; Magic portable lamp guard. Represented by Henry F. Gilg, J. W. Place, J. C. Campbell and Miss Martha M. Gilg. Space 125.

Goddard & Goddard Company, Detroit, Mich.—Profile and formed type milling cutters; milling cutters adapted to railway work; gear hobs; thread cutters; inserted blade expansion reamers. Represented by C. W. Davison, S. H. Gratan and C. S. Goddard. Spaces 178 and 179.

Graham-White Sander Corporation, Roanoke, Va.—Graham-White manual control and remote control sanders; Graham-White special hook-up for selective sanding; Graham-White manual control and automatic control sand spreader; Graham-White sanders for light-weight, high-speed trains and other Diesel units; Doarnberger type boiler wash-out plugs; Graham-White tilting spring car snubber. Represented by James Frantz, Virgil L. Frantz, Frank H. Cunningham and Clyde Keever. Spaces 40, 41, 48 and 49.

Grip Nut Company, Chicago.—Reception booth. Represented by John H. Sharp, L. W. Kass, E. H. Weigman, T. E. Scully and E. W. Hibbard. Spaces 231, 232 and 233.

Gustin-Bacon Manufacturing Company, Kansas City, Mo.—Lock-Tite pins; locomotive cab seats; locomotive cab side ventilators; emergency brake pipe repair couplings; locomotive throttle rod stuffing boxes; locomotive air pump strainers; brake pipe clamps. Represented by Glenn R. Miller, W. E. Davis and Roy P. Williamson. Spaces 180 and 181.

Holland Company, Chicago.—Holland Volute friction bolster springs. Represented by Cyrus J. Holland and Cyrus E. Holland. Spaces 219 and 220.

Hulson Grate Company, Keokuk, Iowa.—Tuyere-type locomotive grates with unit finger castings. Represented by H. N. Gardner, J. W. Hulson and A. W. Hulson. Spaces 145, 146 and 147.

Hunt-Spiller Manufacturing Corporation, South Boston, Mass.—Rough and finished locomotive parts of Hunt-Spiller Air Furnace Gun Iron, including cylinder bushings, piston valve bushings, cylinder and valve packing rings consisting of standard Duplex and Dunbar sectional rings, combination iron and bronze, Duplex sectional rings and Duplex lip sectional rings of both bronze and combination bronze and iron; Hunt-Spiller Z-type plate pistons; Hunt-Spiller light-weight piston valve with Duplex sectional valve packing rings; three-piece sectional packing rings for air pump and power reverse gear service. Represented by V. W. Ellet, E. J. Fuller, F. W. Lampton, D. F. Hall and C. L. Galloway. Spaces 71 and 72.

Huron Manufacturing Company, Detroit, Mich.—Huron washout plugs; Huron arch tube plugs; Huron smoke chamber inspection plug; Huron direct steaming connection; Huron Stapax journal lubricators; tools. Represented by R. J. Sherlock, P. C. Cady, A. C. Ruse, George F. Morgan, L. E. Hassman and B. R. Wetherby. Spaces 185 and 186.

International Correspondence Schools, Railroad Department, Scranton, Pa. —Sample lessons. Represented by C. G. Ash, C. H. Dailey and A. C. Drynan. Spaces 221 and 222.

Lehon Company, The, Chicago.—Mule-Hide cab curtain canvas; Mule-Hide canvas car roofing; Mule-Hide waterproofing and insulating materials; various Mule-Hide specialties for railway cars. Represented by Tom Lehon, J. W. Shoop, H. A. Wolfe, J. E. Eipper and R. J. Mulroney. Space 223.

Leslie Company, Lyndhurst, N. J.—Leslie Tyfon whistles; steam heat reducing valves. Represented by S. I. Leslie and J. J. Cizek. Space 33.

Lima Locomotive Works, Inc., Lima, Ohio.—Photographs of locomotives. Represented by M. K. Tate. Space 97.

Lincoln Electric Railway Sales Company, The, Cleveland, Ohio.—Charts, photographs, etc., concerning electric arc welding. Represented by J. E. Buckingham, J. A. Coakley, Jr., E. W. P. Smith and J. L. Johnson. Space 137.

Lockhart Iron & Steel Company, Pittsburgh, Pa.—XX Vulcan engine bolt iron; Vulcan bloom staybolt iron; Vulcan iron forging billets for locomotive draw and safety bars and passenger car equalizers. Represented by John Porter Gillespie. Space 177.

Locomotive Equipment Division, Manning, Maxwell & Moore, Inc., New York.—Turbo-injector; live steam injector; globe and angle valves; thermometers; tank level indicators; whistles; safety valves; gages. Represented by C. L. Brown, C. H. Butterfield, C. W. Corning, W. J. Hall, F. J. McGourty, N. P. Selover, J. Soule Smith and L. W. Lewis. Spaces 234 and 235.

Locomotive Firebox Company, Chicago.—Nicholson thermic syphons; Cyclone front ends; Christy engine truck lubricators; syphon sanders. Represented by W. S. Carr, G. R. Carr, L. R. Pyle, John Baker, C. M. Rogers, Fred Bramley, E. J. Reardon, M. A. Foss and E. Frank Smith. Space A.

Lunkenheimer Company, The, Cincinnati, Ohio.—Valves and lubricating devices for railroad service, including all patterns of Lunkenheimer "A.A.R." valves. Represented by Harry A. Burdorf and W. George Cook. Spaces 3 and 4.

MacLean-Fogg Lock Nut Company, Chicago.—M-F. lock nuts; M-F nut locks; M-F water-tight bolts; M-F lock-tight floor clips; M-F defect card receptacles; M-F dust guards. Represented by J. A. MacLean, J. W. Fogg, J. A. MacLean, Jr., A. W. MacLean, L. A. Rowe, W. G. Willcoxson, M. Flanagan, H. J. Clarity and A. B. Nilsen. Spaces 103, 104 and 105.

McCabe Manufacturing Company, Lawrence, Mass.—Cold flanged front flue sheet, 1-in. thick. Represented by Fred H. McCabe. Spaces 7 and 8.

ier, Inc., W. H., Chicago.—Small models of friction draft gears and truck spring snubbers. Represented by Bradley S. Johnson. Space 263.

Jern Supply Company, Chicago. — Drills; reamers; beading tools; chisels; chisel blanks; rivet sets; pins and bushings for locomotive and ir spring and brake rigging; staybolt and engine bolt iron; car and locomotive shop jacks; locomotive spring bands; brake shoes; iron and eel castings. Represented by W. F. Weber, A. A. Walker, R. E. Iann, Earle A. Mann, Thomas Jameson, Merle P. Smith and C. A. unn. Space 260.

arch Packing & Supply Company, Chicago.—Allpax packings; Allpax isket cutter; Monarch "V" ring packings; Monarch fibrous and semi-etallic packings. Represented by Stanley MacDole, C. C. Humber-one, W. J. Forbes and W. P. Lyons. Space 126.

han Manufacturing Company, New York. — Injectors; lubricators; oiler checks; low water alarms; water columns; drop plugs; whistles. epresented by C. J. Banning, J. F. Farrell, R. H. Jenkins, H. G. ook, B. E. Folke, J. A. Kelly, F. Ehredt, W. S. Harris and Richard Velsh. Spaces 34, 35, 54 and 55.

ional Aluminate Corporation, Chicago. — Water treating equipment; ater testing equipment; automatic continuous blowdown equipment. epresented by P. W. Evans, C. B. Flint, C. M. Bardwell, B. D. Barger, L. Callahan, R. E. Falkinburg, J. L. Gibboney, R. V. Lucas, V. E. cCoy, H. A. Marshall, E. M. Miller, H. D. Shaw and T. G. Windes. paces 155, 156, 157 and 158.

ional Tube Company, Pittsburgh, Pa.—Spaces, 198, 199 and 200.

ite Products, Inc., New York.—Methods for cleaning air-conditioning quipment; materials for washing steamliners; methods for stripping int from locomotive tanks and coaches. Represented by J. C. Leonard, C. Browning, C. Johnson, L. B. Johnson, H. L. Gray and J. A. arter. Spaces 1 and 2.

dee Company, Chicago.—Blow-off valves; tender hose couplers; steam d air-operated cylinder cocks; cylinder cock operating valves; automatic drain valves; water glass protectors; centrifugal blow-off separators. Represented by A. G. Hollingshead, J. F. Raps and C. W. Ploen. paces 30, 31 and 32.

alley Valve Company, Edward, Chicago. — Tripl-disc valves; valve clamation; master valve reseaters. Represented by Edward O'Malley, ., Edward O'Malley, Jr., and S. C. Boston. Space 42.

eld Railroad Service Company, The, Chicago.—Oxy-acetylene welding d cutting apparatus. Represented by F. C. Hasse, William Jones, A. Smith and J. L. Hoffman. Spaces 183 and 184.

e-Jones Chemical Company, Chicago.—See National Aluminate Corporation.

son Tools, Inc., The, Chicago. — Beading tools, chisels and chisel anks; rivet sets. Represented by A. A. Walker, Earle A. Mann and harles Loucks. Space 259.

on-Mitchell Company, Omaha, Neb.—Paxton-Mitchell metallic piston d, valve stem and air pump packing; slip joint and expansion joint cking for high pressure and exhaust steam pipes on Mallet locomotives; special locomotive iron castings. Represented by James L. Paxton, Jr., James J. Keliher and E. M. Hendrickson. Spaces 123 and 124.

a Iron & Steel Company, Creighton, Pa.—Samples of hand-puddled rought iron, including staybolt, engine bolt and chain iron qualities; ysical test specimens, including pull tests, etch tests, bend tests, read tests, etc. Represented by Charles J. Nieman and J. P. Moses. paces 106 and 107.

od Company, The, New York.—Redesigned Baker valve gear equipped ith Multirol precision bearings; McGill Multirol precision bearings. epresented by R. H. Weatherly and F. Fisher. Spaces 36, 37, 52 d 53.

ket List of Railroad Officials, The, New York.—Copies of The Pocket ist of Railroad Officials. Represented by B. J. Wilson. Space 182.

e Manufacturing Company, The, Milwaukee, Wis.—Prime cylinder otection valves; Prime square thread washout plugs; Prime perfect rcle bushing grinders. Represented by C. K. Ramp and H. B. Nelson. Spaces 135 and 136.

-National Company, The, Chicago. — Turbo-generators; headlights; oodlights; safety switches; wiring appliances. Represented by William Miller, J. A. Amos, George E. Haas, J. V. Baker and W. A. Ross. pace B.

lway Purchases and Stores, Chicago.—Magazines. Represented by F. Sheeran, J. P. Murphy, Jr., and John R. Moulton. Space 262.

ance Machine & Stamping Works, New Orleans, La.—"Spee-D" high ressure grease appliances for locomotive connecting rod lubrication; ew "Spee-D" high pressure terminal and station grease guns, types -8000 and U-6000. Represented by E. B. Norman, George A. Pettit d H. C. Manchester. Spaces 237 and 238.

rson & Son, Inc., Joseph T., Chicago.—Staybolt iron. Space 107.

mons-Boardman Publishing Corporation, New York.—Railway Mechanical Engineer and other transportation magazines and books. Represented by L. B. Sherman, R. E. Thayer, H. A. Morrison, H. H. Melville, H. E. McCandless, L. R. Gurley, S. W. Hickey, Roy V. Wright, B. Peck, E. L. Woodward and H. C. Wilcox. Spaces 228, 229 d 230.

ler, Inc., Joseph, Chicago.—Locomotive packing; master valve repair ts; electrode holders. Represented by Joseph Sinkler. Space 47.

dard Brake Shoe & Foundry Company, Chicago.—Locomotive spring ands; brake shoes; iron and steel castings. Represented by C. K. lliott, A. A. Walker and Earle A. Mann. Space 261.

dard Car Truck Company, Chicago.—Barber stabilized trucks; Barber teral motion device; Barber roller side bearings. Represented by L. Barber, R. E. Frame, F. D. Barber, E. W. Webb and J. B. dgerton. Spaces 171 and 172.

ndard Stoker Company, Inc., The, Chicago.—Working model of type -T stoker; working model of type D-A slope sheet coal pusher; models front or locomotive units of LT-1 Conversion, and Standard modified type B and B-K stokers; improved parts of stokers. Represented F. P. Roesch, W. L. Lentz, Henry S. Mann, A. L. Whipple, C. T. ansen, L. F. Sweeney, C. A. Binney, E. H. Parr, H. N. Carmer, W. Chenault, H. W. Cook, G. A. Edwards and Clarence Welker. Spaces 31 and 132.

beam Electric Manufacturing Company, Evansville, Ind.—Locomotive eadlights and turbo-generators. Represented by J. Henry Schroeder, E. Kinnaw and W. E. Richard. Spaces 151, 152, 161 and 162.

perheater Company, The, New York.—Type "E" superheater unit; exhaust steam injector; centrifugal pump; American multiple-valve throttle; Tangential steam dryer; C. F. feedwater heater pump; coil and tube type feedwater heaters. Represented by G. L. Bourne, F. A. Schaff, R. M. Ostermann, H. B. Oatley, Bard Browne, C. A. Brandt, N. T. McKee, B. C. Wilkerson, E. J. Drewyour, C. H. David, F. Smith, S. Macdonald, E. A. Averill, P. D. Blanchard, B. G. Lynch, W. G. Tawse, G. Dolan, I. F. Sharp, T. McGinnis, L. Bryan, G. Fogg and R. J. Van Meter. Spaces 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92 and 93.

Superior Hand Brake Company, Chicago.—Vertical hand brakes; horizontal hand brakes; drop shaft brakes; hand brake chain adjusters. Represented by H. C. Smith and R. C. O'Connor. Spaces 169 and 170.

Superior Railway Products Corporation, Pittsburgh, Pa.—Superior automatic soot blowers; pneumatic steam valve and operating valve. Represented by G. S. Turner, W. O. Martin, B. H. Lobdell and W. E. Larson. Spaces 25 and 64.

Swanson Company, The, Chicago.—S-CO automatic flange oiler. Represented by O. W. Swanson. Space 9.

Symington-Gould Corporation, The, New York.—Journal boxes; lids; dust-guards; truck spring snubber. Represented by D. L. Townsend and H. T. Casey. Spaces 68 and 69.

Timken Roller Bearing Company, The, Canton, Ohio.—Timken roller bearings for driving axles, engine trucks and trailer trucks of steam, electric and Diesel locomotives, tenders, cars and high-speed trains; Timken bearing to be used under new Pullman cars assigned to the "Broadway Limited" and the "Twentieth Century Limited"; Timken high dynamic steel locomotive main and side rods and reciprocating parts of light-weight design; Timken crank pin bearings and models of railway applications; X-ray photographs. Represented by W. C. Sanders, T. V. Buckwalter, M. S. Downes, J. A. Morland, H. L. Hexamer, R. B. Lewis, M. H. Hykes, C. F. Crowell, R. J. Daniels, P. C. Paterson, C. L. Eastburg and R. M. Ross. Spaces 14, 15, 16, 17, 18, 19, 20, 21, 22 and 23.

T-Z Railway Equipment Company, Chicago.—Locomotive and car devices. Represented by G. S. Turner, J. S. Lemley, F. J. Kearney and F. B. Platt. Spaces 24 and 65.

Ulster Iron Works, Dover, N. J.—Hand-puddled wrought iron, staybolt and engine bolt quality. Represented by C. F. Barton, John H. Craigie, E. W. Kavanagh, N. S. Thulin and H. T. Bradley. Spaces 251 and 252.

Union Asbestos & Rubber Company, Chicago.—Wovenstone pipe covering; Insutape; locomotive packings. Represented by J. H. Kuhns, W. R. Gillies, O. J. Rudolph, G. L. Green and R. M. Covert. Spaces 173, 174, 175 and 176.

Unitcast Corporation, Toledo, Ohio.—Brake balancer; drop end locks; cast steel hopper frames; Unitcast underframe. Represented by George B. Christian, C. M. Hannaford, Cyrus Hankins, Earl H. Fisher and Harvey Russell. Spaces 243, 244, 245 and 246.

United States Metallic Packing Company, Philadelphia, Pa.—King model 36 air compressor lubricator; metallic packing for locomotive piston rods, valve stems and air compressors; locomotive sander; Red Top brake cylinder pressure indicator; models 318 and 3114 lubricators for valves, cylinders driving boxes and guides. Represented by J. J. Ekin, Jr., Clyde Hyslop, Harry E. Hyslop, L. B. Miller. Spaces 236 and 253.

Valve Pilot Corporation, New York.—Loco Valve Pilot for indicating and recording speed and cut-off on steam locomotives; Loco Recorder for indicating and recording speed on steam locomotives. Represented by John L. Bacon, C. F. Pennypacker and W. W. Bacon. Spaces 38, 39, 50 and 51.

Vapor Car Heating Company, Inc., Chicago.—Steam generating unit; fin radiation; single tube compensating thermostat; vapor system specialties. Represented by E. A. Russell, J. Van Vulpen, P. B. Parks and William Smith. Spaces, 43, 44, 45 and 46.

Viloco Railway Equipment Company, Chicago.—Sanders; sander operating valves; bell ringers; bell ringer throttle valves; Whelan by-pass valves; automatic rail washers; pneumatic whistle operators. Represented by A. G. Hollingshead, J. F. Raps and C. W. Ploen. Spaces 57, 58 and 59.

Waugh Equipment Company, New York.—Firebar grates. Represented by Robert Watson and Roy C. Munro. Spaces 5 and 6.

Westinghouse Air Brake Company, Wilmerding, Pa.—Miscellaneous air brake devices. Represented by S. G. Down, C. D. Stewart, J. B. Wright, C. D. Foltz and C. C. Farmer. Spaces 115, 116 and 117.

Wilson Engineering Corporation, Chicago.—Diagrammatic transparency of locomotive feedwater heater; model exhibit board of locomotive blow-off equipment; centrifugal blow-off separators; sludge removers. Represented by J. J. Clifford, J. M. Lammedee, H. J. McGrath, C. E. Murphy, J. Welsh and L. F. Wilson. Spaces 129 and 130.

Wine Railway Appliance Company, The, Toledo, Ohio.—See Unitcast Corporation.

Woods & Company, Edwin S., Chicago.—Freight car, passenger car and locomotive tender truck roller bearings. Represented by Knowles Pittman and C. S. Shilling. Spaces 159 and 160.

Yale & Towne Manufacturing Company, The, Philadelphia and Stamford Divisions, Philadelphia, Pa., and Stamford, Conn.—Hoisting equipment; railway switch and pad locks. Represented by R. J. Arehart and W. C. Bigelow. Space 70.

Fuel and Traveling Engineers

(*Continued from page 388*)

and forceful in his actions and manner of speech. He makes friends easily and holds them. A sidelight on his personality is afforded by an incident which took place when he was leading a class in the fuel instruction car, soon after his appointment to that position. A fireman challenged a statement which he made, with the assertion that what he claimed in connection with a hand-fired locomotive was impossible. Mr. Clark immediately

dismissed the class, asked the fireman when he would go out on his run, put on his overalls and said, "I'm going out with you, and if I am unable to demonstrate the truth of what I have been teaching I am through as instructor."

Secretary-Treasurer Smith

Thomas Duff Smith, more familiarly known as T. Duff Smith, is secretary-treasurer of the association. He was born in Essex, England, October 2, 1868, and after attending the British public schools, was employed on the London Corn Exchange from 1884 to 1906. He came to Canada in February, 1906, taking a position as fuel clerk on the Canadian Pacific at Winnipeg, Man. He was promoted to chief fuel clerk, November, 1908, remaining in that position until May, 1911, when he went with the Grand Trunk Pacific at Winnipeg, as fuel agent. In April, 1922, he was made lake forwarding agent of the Canadian National Railways at Cleveland, Ohio, retiring from railway service December 31, 1931. He joined the International Railway Fuel Association in 1910 and has been on the executive committee of that organization ever since. He was its president in 1912. On May 1, 1932, he became secretary-treasurer of the International Railway Fuel Association, succeeding to the same position in the new organization on the amalgamation of the Fuel and Traveling Engineers associations.

"Duff," as he is familiarly known, is a canny Scotchman and it is largely due to his careful management that the Fuel Association came through the depression in such excellent financial condition, in spite of holding quite extensive technical sessions and publishing annual proceedings each year except 1932. His forceful personality and genius for organization work was never better demonstrated than while he served as a member of the Co-ordination Committee, which succeeded after months of effort in effecting the amalgamation of the International Railway Fuel Association and the Traveling Engineers' Association. Outside of working hours he has plenty to occupy his mind. His avocations include photography, fishing, golf and gardening.

Master Boiler Makers' Association

(*Continued from page 391*)

general boiler department foreman, and has remained in that position until the present time.

He was president of the Capitol District of the New York Central Athletic Association, 1928-1930, and is now vice-president of the Capitol District, New York Central Veterans' Association. He was president of the Albany City Bowling League in 1928-29, and takes a keen interest in base ball and foot ball.

He became a member of the Master Boiler Makers' Association in 1920, was elected to its executive board in 1924, and was chairman of that board in 1926. He was elected secretary of the association in 1931 and in 1936 became its secretary-treasurer. He has fought hard to preserve the association and revive its activities; indeed, it was largely through his efforts that meetings of the association have been held during the past two years. He is easy to approach and not hard to get along with; on the other hand, no one who knows him well would ever accuse him of being a "yes" man. He is foreman of one of the largest boiler shops in the eastern district and has the reputation of knowing how to handle men and get the work out.

Car Department Officers' Association

(*Continued from page 394*)

strength and at a great saving in weight. The Hiawatha trains, which have proved so popular and have demonstrated their earning capacity, were designed and built under his supervision.

The Secretary-Treasurer

Adam Sternberg, formerly master car builder, Belt Railway of Chicago, became secretary of the car department officers' organization in 1924, and since that time until his recent retirement, was one of the most active workers in the organization. He retired from railroad service in June, 1935, and because of removal from Chicago to Cedar Lake, Ind., found it necessary to retire from the secretaryship of the association. Frank Kartheiser, chief clerk to the mechanical assistant to the executive vice-president of the Chicago, Burlington & Quincy, has been appointed acting secretary, pending the election at the convention this month.

General Foremen's Association

(*Continued from page 397*)

trified. It was up to the Kingsland shops to prepare the equipment for operation and to look after its maintenance; the new program was inaugurated smoothly and the work has been carried on most effectively.

Secretary-Treasurer Hall

William Hall, who, because of illness, recently resigned as secretary-treasurer of the association, was one of its charter members. In 1909 he was elected secretary to the executive committee and in 1910 secretary of the association. He continued in this position, the by-laws in 1916 being amended to make the office permanent, rather than elective annually.

Mr. Hall was born in Bromsgrove, Worcestershire, England, July 12, 1856. He was educated in an English church school and at the age of 14 was entered as machinist apprentice on the Midland Railway, now the London, Midland & Scottish, at its Bromsgrove works. He was transferred four years later to the Manchester shops to complete his mechanical education and apprenticeship of seven years. He served as a journeyman machinist at these shops until September, 1881, when, with Mrs. Hall, he decided to emigrate to the United States. He secured a position with the Chicago & North Western, but in 1891 left that company to go with the C. F. Elmes Engineering Works, a marine and jobbing shop. He returned to the Chicago & North Western two and a half years later, and in 1898 was made gang foreman in the main shops at Chicago. He was transferred to Escanaba, Mich., in 1903, and was made general machine shop foreman. In 1913 he was transferred to Winona, Minn., as erecting foreman, remaining there until his retirement in 1923.

While in Chicago he assisted in organizing the Chicago & North Western Mutual Aid Society, serving as its secretary for many years. He was elected a member of the Board of Education of Winona, Minn., in 1915, serving 12 years in that capacity, two as president of the board.

As a charter member of the International Railway

General Foremen's Association, as an indefatigable worker in its interests; and as its secretary-treasurer for many years Mr. Hall has been a prime factor in its upbuilding and success.

Modern Locomotive Equipment-II

(*Continued from page 385*)

applications incorporated features of both designs 1 and 2, which would give stresses more favorable than those shown in Fig. 10 and Table VI.

Tests of Main-Rod Front Ends

Similar strain-gage tests were also made on the front end of the main rod to determine the stresses in the rod due to both the cylinder pressure and the press fit of the crosshead pin in the rod. The results of these tests are shown in Fig. 11 and Table VII. The stresses in the rod resulting from the 0.004-in. press fit of the crosshead pin were measured first, and are shown by the broken-line curves in the figure. Then a 117,400-lb. pull was applied on the rod, increasing the stresses to the values shown by the full-line curves, which represent the combined stress due to both the press fit and the pull. The pull force on the rod increased the stress by 17 per cent at section *N* and 36 per cent at section *U* over that due to the press fit. The variation in stress in going from tension to compressive forces in the rod will therefore be small in actual operation and this is a favorable condition for maximum fatigue strength. The measured stress at section *U* in the bore is 1.7 times the nominally calculated direct stresses, $P/2A$, and 2.6 times at section *N*. The measured stresses due to the press fit give reasonable agreement with calculated values based on Lamé's formula in view of the assumptions necessary in making such a comparison.

It is necessary to maintain sufficient press fit of the pin in the rod if it is not to work loose in service. Besides the tests just mentioned additional tests were made on the front end of the main rod. The results of these tests indicate that it is desirable to make the rod eye from 0.002 in. to 0.004 in. tight on the crosshead pin.

Crosshead Test

A comparison illustration of the assemblies constituting the reciprocating parts is shown in Fig. 4 for the lightweight and conventional designs. The usual design of taper-key fit of the piston rod in the cast steel crosshead contributes considerable weight to the reciprocating parts and is not used in the Timken design. In this lightweight design a piston rod having a ¾-in. wall section is keyed by three integral annular grooves on the end of the piston rod to a crosshead consisting of two thick die-forged side plates as shown dissembled in Fig. 12.

Stresses in the piston rod at the base of the annular grooves were determined for two different designs of annular-groove systems and these designs as well as test results for both are shown in Fig. 13 and Table VIII. The bolts were drawn equally tight for the test on each design. The stresses in the bolts were determined by measuring the change in length of each bolt with 0.0001-in. dial gages. Consideration of the factors of magnitude and uniformity of stresses in Table VIII leads to the selection of the second design, which is the one that was adopted for actual service applications with slight modifications. The stresses given are average stresses at the surface of the piston rod based on a gage length of 1⅜ in. and the local stresses adjoining the fillets at the base of the annular grooves would be higher than the stresses shown. These fillet stresses, however, are calculated to be well within the endurance limit of the steel.

For locomotive applications, the system of annular rings is machined to close tolerances, using gages, and then the piston rod is lapped-in to the crosshead body. By this procedure the desired fit and magnitude and distribution of stresses in the crosshead assembly are obtained.

* * *

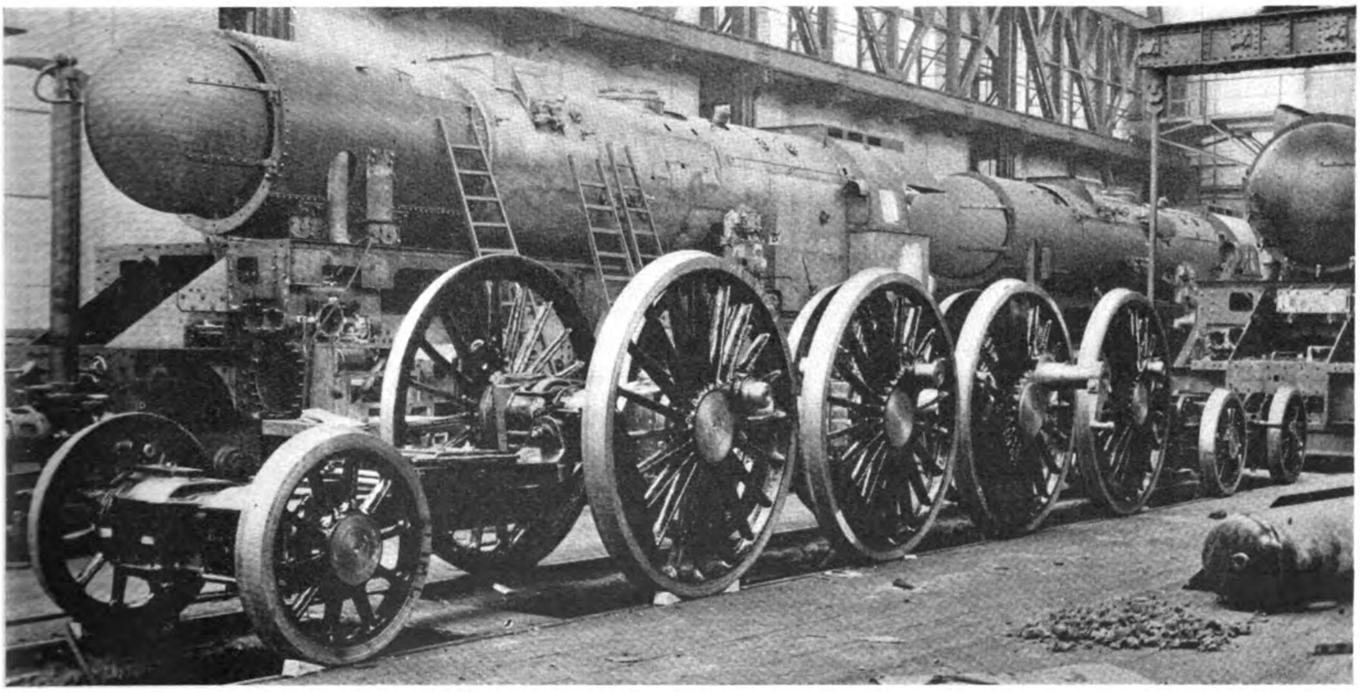


Photo by Underwood and Underwood

Locomotives under construction in the builder's plant at Vienna, Austria

EDITORIALS

New Ideas Change the Character of Shop Work

The methods and facilities now being used by railroad shops in an effort to keep up with the demand for motive power and rolling stock are especially impressive because of the many new things that are coming into use. Railroads have long been criticized because they do not make use of modern ideas but the critics would have a difficult time justifying their statements if they had the privilege of seeing what we see in our every day work. A few instances will serve to illustrate the point. In these days of high-speed train operation, wheels are of greater importance than ever before, and it is not only necessary to turn wheels out of the shops at a faster rate in order to supply the demand, but the quality of workmanship must be better than ever before. This demand has made necessary the installation of many new car and driving-wheel lathes replacing old and worn out machines. These new machines are making it possible to increase production and insure absolutely true and round wheels. In one wheel shop visited recently the production of the shop a year ago was limited by obsolete equipment in the demounting section and the necessity of handling wheels and axles by hand. Within the past six months this section of the shop has been completely re-equipped with new hydraulic demounting presses and wheel and axle-handling equipment that now make it possible to demount 160 pairs of wheels in eight hours without a man handling a single pound of weight.

Air-conditioned passenger cars and the demand for better windows has brought in the double-pane plate-glass windows which, to prevent frosting, must be dehydrated. One road has set up a rather elaborate department in the shop with equipment to do this work which, among other things, involves the use of many vacuum devices and gas dehydrating equipment.

In the passenger-car field there will be observed the increasing use of properly designed exhaust spray hoods for use in painting not only complete cars but many car parts. In steel-freight-car work, the spot system, which has been developed to a high degree on the railroads is being improved every day and among other things of interest is a welding station which, by the use of special pneumatic equipment, clamps the entire car in place while six men weld the body together by means of electric welding equipment.

New machine tools are meeting a demand for increased production and greater accuracy. In four shops $700,000 worth of new machinery has been installed within the last two years. Many of these new machines are equipped with special jigs and fixtures for speeding production and dial gages and micrometers are being used extensively to check the accuracy of operation. Special alloy tool steels are used to decrease cutting time and to increase the number of pieces that may be machined between the grindings of tools.

Taper bolts, that until a few years ago were a hand-made job on a portable engine lathe, are today being selected and ordered by gages and produced on specially equipped turret lathes capable of producing 500 bolts of various sizes each working day.

Rebuilding of worn parts has brought plating and metal-spray equipment into the railroad field. In one case that came to our attention just recently the equipment has paid for itself five times over in a period of less than a year and a half. Electro-plating is being used on many parts such as locomotive main and side rods for protection against corrosion.

Safety is ever important around railroad shops. In several instances on punch-and-shear work the photo-electric cell is used to make it impossible for a man to operate a machine while his hands are in the danger zone.

The use of automotive engines on rail cars, shop trucks and for various other uses has made it necessary to set up complete internal-combustion-engine repair departments with modern dynamometer equipment such as used in the builders' test plants.

One could enumerate dozens of other instances of equipment that was entirely foreign to railroad shops five years ago.

The Way Out of A Difficult Situation

The successful and profitable operation of a railroad is an eternal problem of performing the tasks incident to furnishing transportation within the definite limits of revenues that are fixed by the volume and nature of its traffic. Unlike many more flexible industries it is not possible, when increased expenditures are anticipated, to stimulate sales immediately and sufficiently to provide additional revenue. Therefore railroad management has but two courses open when revenues decrease or expenditures increase—either to lay off men or reduce the cost of operation by improved methods and facilities.

During the past five years the roads have been increasing expenditures for new facilities in the shops and enginehouses, and as a result of actual experience with many of the new units of equipment recently installed are now in possession of cost data that provides positive proof of their money-saving possibilities. Those who are

in everyday contact with the problems of operation know that the opportunities to eliminate the losses due to inefficient methods and obsolete facilities are almost endless.

The railroads are faced with the necessity of adjusting expenditures to meet the new and anticipated wage increases. Is this going to be accomplished alone by reductions in the hours of work performed, with resultant undermaintenance, or has the time arrived for management to take a broad-gaged view of a difficult situation and meet it by initiating a program of shop modernization that will cut the cost of maintaining cars and locomotives. The situation today is one of choosing between a temporary expedient and a constructive program which will produce permanent economies.

Why Not Balance The Car Wheels?

At the Mechanical Division convention last June, L. K. Sillcox, first vice-president, New York Air Brake Company, said that a 1-in. flat spot on a 36-in. passenger-car wheel rotating at a rate equivalent to 100 miles an hour car speed, produces a dynamic effect on the rail approximately twice that of a 2½-in. flat spot on a wheel of the same diameter revolving at a rate equivalent to 60 miles an hour car speed. This fact simply serves to emphasize the vital necessity of giving special attention to rotundity, concentricity, and balance of car wheels used on passenger equipment which is operated in modern ultra-high-speed service. It cannot be questioned that many harmful wheel and rail reactions, due to off-balance conditions, exact their toll in equipment damage and reduced serviceability, even though these reactions may be concealed, to a certain extent, by effective car springs.

Regarding this subject Mr. Sillcox makes the following comment: "Rotative speeds of wheels under railway rolling stock are relatively low, as judged by automotive engine or turbine standards, but the weights involved are, as a rule, much greater. Balancing of railway wheel and axle assemblies has never been practiced by our railways except in the case of locomotive driving wheels where the condition would otherwise be intolerable, due to suspended weights. In England and on the Continent, the actual dynamic balancing of locomotive driving and passenger-car wheels has long been practiced, and is considered essential to the most favorable riding qualities and of true economic advantage. In this country, balancing methods and devices have developed commercially to a higher degree, but research in dynamic balancing has been conducted independently of any railway interest. First developed for small parts and gradually extended in capacity to receive large motor armatures, these balancing machines have as yet found no place in railway shops. Progressively increasing speed will emphasize the necessity for maintaining closer tolerances than those allowed at present. High-speed trains should, no doubt, operate on wheel and axle assemblies which are entirely free from dynamic disturbances. This will combine with associated refinement in truck design and control of truck-car-body reactions to improve materially the riding and tracking characteristics of the equipment. . . ."

A number of railways in this country have found that complaints regarding hard-riding equipment could be remedied by simply turning the car wheels, which were badly out of balance, and that no further change in the truck spring arrangement was required. However, particularly in the case of light-weight high-speed trains, it is now quite common practice to take a light finishing cut over practically the entire car wheel and grind the treads concentric with the journals, thus making sure that the wheels are in accurate balance. In all probability more of this work will have to be done in the future than in the past and it is highly desirable for railway mechanical officers to familiarize themselves with the best methods of balancing car wheels both statically and dynamically.

The New Interstate Commerce Commissioner

With the appointment of John L. Rogers to membership on the Interstate Commerce Commission, succeeding Hugh M. Tate, the Commission now has among its eleven members two who have had practical experience in the mechanical department—Frank McManamy and Mr. Rogers.

There are two schools of thought concerning the requisites of an ideal commissioner. One is that he should be a man of broad experience, of open mind and sound judgment, but not necessarily having had practical experience in railway operation, since the Commission has men of technical training and practical experience on its staff who can be looked to for advice on such matters. There is another school of thought which insists that in addition to a broad understanding of men and affairs and a judicial mind, it is important that a commissioner have some practical experience in the field with which the activities of the Commission are concerned. The Commission has been made up largely of men of legal training; occasionally a practical railroader has been selected, a notable example being that of Edward E. Clark, who was a railroad conductor and became the head of the Brotherhood of Railroad Conductors before he entered public service.

Be that as it may, it must be recognized that more and more has the Commission been forced to consider highly technical problems in connection with railway operation. It seems well, therefore, that some of the commissioners, at least, should have a rather thorough practical and technical knowledge of railway practices, and it would seem fortunate that two of the present

commissioners have had a certain background of mechanical-department experience, since the equipment designed and maintained by that department bulks so large in the problems with which the Commission is concerned.

Frank McManamy entered railway service in the maintenance of way department of the Pennsylvania, and then was employed on various other railroads in the maintenance of way department and as a shop employee, locomotive fireman, locomotive engineman, air brake instructor and engineer of tests. For a time he was manager of the western district for the air brake department of the International Correspondence Schools. In entering the service of the Interstate Commerce Commission as an inspector of safety appliances, February 8, 1908, and as a member of the committee which drafted the present safety appliance standards, his work was quite in line with and a natural development of his previous experiences on the railroads.

In 1911 he was made assistant chief inspector of locomotive boilers of the Interstate Commerce Commission, and was promoted to the chief inspectorship in 1913. In February, 1918, when the railroads were operated under the direction of the United States Railroad Administration, he was made manager of the Locomotive Section, retaining his office with the Interstate Commerce Commission, but resigning from it on July 1, 1918, to become mechanical assistant to the director of the Division of Operation of the United States Railroad Administration, having jurisdiction over the car repair and inspection and test sections, and general charge of matters pertaining to locomotive and car equipment. At the termination of federal control he was made manager of the Department of Equipment, Division of Liquidation Claims, of the Railroad Administration. He returned to the I.C.C. in 1923, serving as its chairman in 1930.

John L. Rogers, like Mr. McManamy, had practical experience on the railroads and is also a career man in the Commission. As a young man and before he attended the University of Tennessee and George Washington University, from the latter of which he received the degree of mechanical engineer, he was employed in the mechanical department of the Southern Railway as a helper in the machine shop and then as an apprentice in the boiler department. He worked in both the Knoxville and Birmingham shops of the Southern. After leaving college he entered the service of the Interstate Commerce Commission in 1917 as a mechanical engineer in the Bureau of Locomotive Inspection. Meanwhile he attended the National University Law School in the evenings and was admitted to the bar. He was made special examiner in the Bureau of Service in 1925, playing an active part in investigations involving refrigeration charges, locomotive equipment and the six-hour day for railroad employees. In 1933 he was appointed executive assistant to Co-ordinator Eastman and later, on the organization of the Bureau of Motor Carriers, was appointed chief of that bureau. While his activities in recent years have not been related directly to mechanical department activities, his early experiences before going to college and later with the Bureau of Locomotive Inspection, have given him a good technical background for dealing with mechanical-department problems that come before the Commission.

Commissioners McManamy and Rogers, with Judge Charles D. Mahaffie, bring the number of career men now on the Commission to three out of a total of eleven; this tendency to increase the number of members on the Commission who have had intimate acquaintance with railroad practices seems quite logical, in light of the increasing number of complicated technical problems which come before that body.

New Books

MODERN RAILWAY WELDING PRACTICE. *By Dipl. Ing. O. Bondy, M. I. Struct. E. Published by The Railway Gazette, 33, Tothill street, Westminster, S. W. 1, London. 128 pages, 8 in. by 5½ in. Price, five shillings net. $3.*

This book on welding practice originated in a series of special articles in English publications—The Railway Engineer and the Railway Gazette—dealing with various branches of railway practice in which welding has proved satisfactory. It is intended to provide concise information on a number of specific fields of application for welding and to assist engineers in the further development of new and important applications. There are eleven chapters in the book, Chapters II, III and IV dealing with the application of welding to rolling stock. Other chapters discuss welding regulations in various countries, with particular reference to those of Germany; welded station roof structures and bridges; welding of rails, etc.

DRILLING AND SURFACING PRACTICE. *By Colvin and Stanley. Published by McGraw-Hill Book Company. New York. 431 pages, 5½ in. by 9 in., cloth bound. Price, $4.*

There are few machine operations which have not undergone changes, many of them significant, since the beginning of the depression. In this treatise on drilling, reaming and tapping, planing and slotting, milling, and broaching, it has been the purpose of the authors to illustrate the most up-to-date practices and to present, in compact form, much information which has not hitherto been available. There are seven chapters in the section on drilling which deal comprehensively with the details of practice for drilling in brass, molded plastics, and wood, as well as in iron and steel. A chapter is devoted to reaming and tapping. There are eight chapters which deal with planers, shapers and slotters in which these various types of machine tools are described and the methods of surfacing with them set forth. Milling and milling cutters are dealt with in twelve chapters and broaching in three.

Gleanings *from the* Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

Sensibly Applied Hand Brakes

Oh, what a gift it would be to give the man on the firing line a *car built with sensibly applied hand brakes,* and not cars built and then equipped with hand brakes, with no thought given to maintenance. The present application of hand brakes costs the railroads of this country many thousands of dollars and days delay to maintain, due to no thought given this important factor by car designers. Simple arithmetic and application of lessons learned from actual experience can almost eliminate this expense.

Human Relations in Railroading

What we need today is more "lubrication" among our workers and more sympathetic understanding. * * * * I have spent about 32 years in a large railroad shop, most of this time in a position where I have had to study human nature. To do so, I have tried to place myself in the other man's shoes, so to speak, and meet him on his own level. In so doing I have found human nature the same in all men—but each one is tempered differently; psychology, however, works the same on all. In other words, very few men can stand to be driven to anything, but on the other hand there is stored away somewhere in every man's mind a desire to do things, if it can be brought to the surface and put to work. I believe this can only be done by meeting every man on his own level and helping him to understand that he has a place to fill, is endowed with certain inclinations, and that his success in life depends entirely on how well he develops his powers. When I say this I am not talking at random, but from long and intimate experience.

Making the Public Railroad-Minded

The great fairs and expositions which are frequently held in different parts of this country furnish the railroads an excellent opportunity to educate the public to the advantages of railroad travel. Ed Hungerford's "Wings of a Century" at Chicago and Cleveland emphasized in a realistic and dramatic way what the railroads have meant to our country. Unfortunately, too many of our people have had little, if any, experience in traveling on a railroad. What would be your attitude toward railroad travel if you were an adult and had never spent a night on a Pullman car, or even eaten in a diner? Watch the intense interest of people of this sort in looking over a railroad exhibit—the important thing is to get them to see how natural and simple it is to travel in such cars. They are hesitant about tackling something they have never experienced and apparently are just a bit afraid of surrendering themselves into the hands of the porters and dining-car attendants. There is another thing about the attention interest of exhibits. Did you notice at Atlantic City in June, when the great exhibition was thrown open to the public, that the average man, woman or child seemed to be entranced at anything that was moving, no matter whether it was simple or complicated, or whether they understood it or not? With so many expositions taking place, it would seem that the railroads should make a scientific study to determine just what sorts of exhibits will be most instrumental in stimulating a travel interest on the part of the public.

Technological Improvements

Much has been said about unemployment caused by technological improvements. We must not overlook the fact, however, that many of these improvements not only do not displace workers, but actually create employment for large numbers of people. Who, for instance, has lost his job because of the application of air conditioning to railroad passenger trains, and, yet, think of the large number of workers, many of them in relatively high wage and salary brackets, who have had to be added to the payroll to supply the air-conditioning equipment and to operate and maintain it? Or take another striking development on the railroads, which also came out of the heart of the depression—high-speed, streamline trains. Who has lost a job because of the installation of these trains? Surely they have done much to rejuvenate and spruce up the railroads, and just think of the number of people who have been employed in the design, construction, operation and maintenance of this new equipment. Surely the high standards of operation necessitated by its introduction require more and better trained employees throughout the organization; for instance, even the roadbed over which these trains travel has had to be greatly improved.

Light-Weight, Welded Hopper Cars

A subject of increasing interest in the railroad industry today is the construction of light-weight, all-steel, welded cars, a departure from conventional designs in which rivets are extensively used. As applied to freight cars it is the experience of this writer that by careful study of construction principles, using alloy steels and electric welding throughout, a marked reduction in weight can be accomplished without sacrifice of strength.

Confining this discussion to the all-steel hopper car, it is particularly interesting to observe that many such cars of the conventional design, though rated as 50-ton nominal capacity, are not capable of carrying 50 tons of anthracite coal, based on 52 lb. per cu. ft., due to limited cubical capacity, notwithstanding the fact that they are, of course, equipped with 5½-in. by 10-in. axle journals. Indications are that for this commodity the car that will actually carry 50 tons of coal is the one in demand. It is not an uncommon observation to see cars of larger capacity loaded to only two-thirds their capacity and loads divided in cars of even smaller capacity.

Assuming, therefore, that the 50-ton car is popular with the collieries and coal dealers, why should we not concentrate on a coal car of this size, i.e., a car having a revenue load capacity of 50 tons? It does not necessarily follow that the body of such a car must be carried on 5½-in. by 10-in. journals, merely because the A.A.R. rules so provide. It is apparent that we are on the threshold of a new era of car development, and if the cost of light weight steels of proven strength justifies, it is the judgment of your correspondent that we should take advantage of what our engineers and metallurgists offer in this field, and design a hopper car capable of transporting a pay load of 50 tons of anthracite, utilizing trucks having 5-in. by 9-in. axle journals rather than journals of 5½-in. by 10-in. dimensions.

A.A.R. Rule No. 86 sets out a total weight of 136,000 lb. on rail for a car of 80,000 lb. nominal capacity, for which journals of 5-in. by 9-in. dimensions are specified. Assuming that a 50-ton car with 5-in. by 9-in. journals could be constructed of special light weight material, with a tare weight of 36,000 lb. or less, would it be proper and economical to increase the weight by utilizing 5½-in. by 10-in. journals, for which the rule allows a total weight of 169,000 lb. on rail? Obviously if this procedure were followed it would result in a car of undesired capacity—approximately 70 tons—and defeat the objectives sought with light weight steel.

THE READER'S PAGE

What Causes Thermal Checks in Wheel Hubs?

To the Editor:

Thermal checks in wheels have received considerable study because they are recognized as points of potential failure. The research and publicity given this subject pertains to thermal checks located on the wheel tread. Has any study been made of thermal checks in the hub faces of engine-truck wheels? This type of defect has been occurring on the road where the writer is employed and he is anxious to ascertain if this type of thermal check is peculiar to that railroad?

These checks appear on the hub face of the engine-truck wheels of both passenger and freight locomotive engines. They vary in length from 1/64 in. to 4⅝ in. and always extend radially toward the axle fit; however, they appear around the hub face in fairly well established concentric bands sometimes having a width as much as 4¾ in. In some instances, the number of cracks visible to the eye has been half a dozen, but more often there has been several thousand. The small checks of course predominate with only from four to possibly eight or ten having a length of more than an inch.

The concentric bands of radial checks previously mentioned will appear in no predetermined location on any one wheel; however, in most cases they are fairly close to the axle fit, and generally a number of the checks extend all the way to the axle fit. All wheels are scrapped if thermal checks are discovered within 1 in. of the axle fit, or where the length of the longest single check exceeds 2¾ in.

Wheels with these thermal checks usually crack while being pressed off the axle. In such cases the fracture will extend through the wheel hub and has extended, in some instances, to the rim of the wheel. In most cases, two fractures, directly opposite one another will occur, and in every case the crack will be through a thermal check.

The writer would like to know if other roads are experiencing similar difficulties from thermal-checked hub faces of engine-truck wheels. What are their causes? Can anyone suggest a remedy?

General Foreman.

Drill Tang Breakage

To the Editor:

Noting in the June *Railway Mechanical Engineer*, page 270, "Drill Tang Breakage," prompts me to send in herewith details that I believe would prove interesting to many of your readers. Having enjoyed many years of experience on drilling and mechanical detailing, I am well aware of the difficulties arising in drilling.

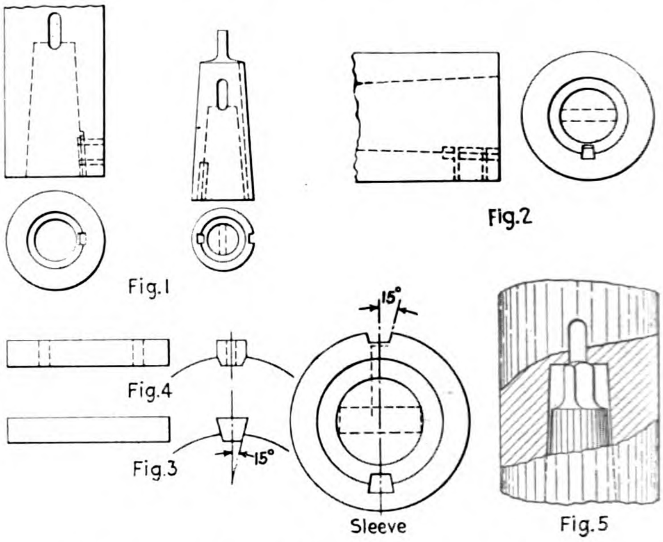
You state there are two precautions that must be observed in preventing drill breakage. My experience shows that the expert drill man notes at least a dozen precautions in successful drilling. Some of these are:

1—The tang of the drill must be in good order—square, not rounded off by friction of wear.

2—The tang seal must be square and not rounded off by friction of wear.

3—The drill shank must have good frictional contact with the drill socket.

4—The point of the drill must be of the correct angles for the work so that the liability of excessive advancement of the drill is prevented. Excessive rake and clearance may cause the drill to advance suddenly and loosen in



the socket; then the spindle rotating over the tang end causes havoc, ruining both spindle and tang. This happens too distressingly often in many shops (Fig. 5).

5—The drill must have proper clearance determined by competent inspectors in the tool crib by the aid of a micrometer.

6—The work must be firmly held.

7—The drill edge should be brought to the work with care.

8—The drilling feed on normal work should be positive. No hand feeding being permitted.

In summing up it has been noted that trouble starts from a lack of exactness in driving the drill home in socket, for innumerably times the operator, in quickly forcing the drill tang to the seat, will cause the edge of the tang to rub slightly or chip the seat of the tang. Thus, both tang seat and drill tang are eventually rounded off, hence, trouble and breakage results (Fig. 5). The proper solution of the problem lies in the reconditioning of all boring-mill and drill-press spindle sockets and sleeves and with the insertion of the key in the socket, necessitating the splining of the socket seat of all drills, sleeves and boring bars (Figs. 1, 2 and 3). The dovetail key, Fig. 3, is of the preferential form. However, the key is often made as Fig. 4, square seating with good fitting and two pins driven in and riveted over. The width of the key is standard at seating of the bores, but the thickness of the key may be less than the width. The side angle of the driving face of the key must be 15 deg.

The procedure herewith illustrated seems a formidable order but the increased efficiency would make the job well worth while in any large shop.

P. Rattek.

With the Car Foremen and Inspectors

Devices for Repairing AB Brake Valves

*By T. H. Birch**

The advent of the Type-AB air brake necessitates developing special tools and devices to facilitate making repairs to AB valves in the most efficient manner. Several devices designed and used for this purpose at the Chicago, Milwaukee, St. Paul & Pacific shops, Milwaukee, Wis., are shown in the illustrations.

In dismantling and assembling accelerator release piston springs the jig, illustrated in Fig 1, proves of great assistance in overcoming the stiffness of the spring. The jig consists of a top plate 3 in. wide by 5½ in. long and drilled with a 1 7/16-in. hole at the center. This plate is secured by nuts to two ⅜-in. rods capable of vertical movement through the bench top and a hardwood block guide, the lower ends of the rods being suitably connected to a foot press and fulcrum underneath the bench. The use of this device enables the accelerator release piston spring to be compressed by operation of the foot treadle and leaves the hands free for dismantling and assembling operations.

The particular merit of the stand and clamp, illustrated in Fig. 2, for holding portions of the AB valve while being repaired is its flexibility and the fact that it can be used for holding firmly the different parts of the valve at whatever elevation is desired, for most convenient operation. This device consists of an angle bracket and clamp welded or riveted to the top of a vertical screw which passes through a nut welded to a base plate which is supported on four pipe nipples at the proper elevation above the top of the work bench. The angle bracket, made of 7/16-in. by 4¾-in. stock, has a horizontal leg 6¾ in. long and a vertical leg 8⅜ in. long. The vertical leg is drilled with a 1 1/16-in. hole, 1⅜ in. above the bottom of the bracket and 1½ in. from one side. The hand clamp which holds the AB valve part firmly in the angle bracket consists simply of a U-shaped piece of steel made of 3/16-in. by 1½-in. stock, drilled at the rounded end of each leg with an 11/16-in. hole for attachment to the brake-valve part and provided with a ⅜-in. valve handle and screw for holding the valve firmly against the vertical leg of the angle bracket.

The adjusting screw used to vary the height of the angle bracket is 11 in. long and has a 1½-in. standard thread; it is equipped with a lock nut and convenient welded handle which may be tightened to hold the screw at any angular position desired. The base plate to which the 1½-in. standard guide nut is welded is ½ in. by 6 in. by 8 in. and is supported on four ½-in. pipe nipples 6 in. long with ⅝-in. bolts extending through them to hold the fixture rigidly on top of the work bench.

*Air brake foreman, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis.

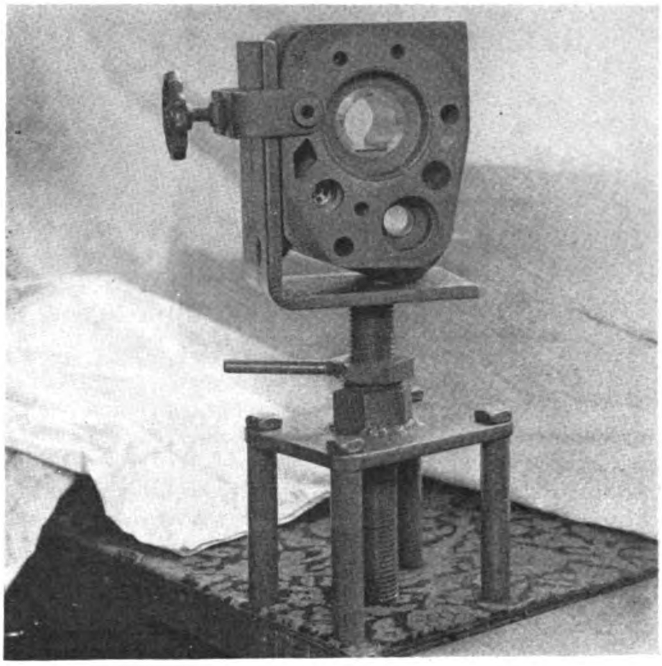


Fig. 2—Stand and clamp for holding AB valve portions while doing repair work

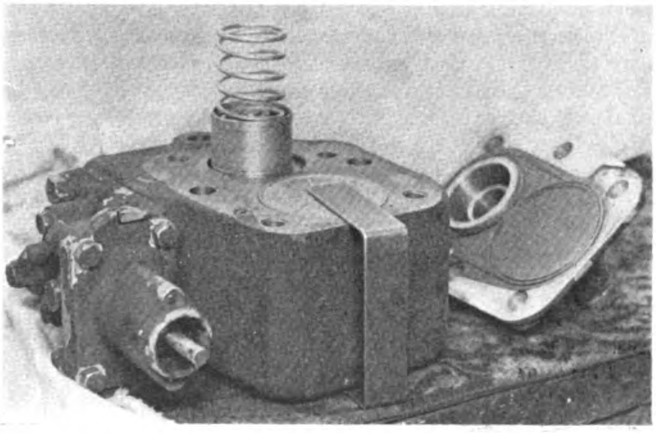


Fig. 3—U-clamp for holding by-pass check valves, springs, seat and stop in place while applying the service-valve cover

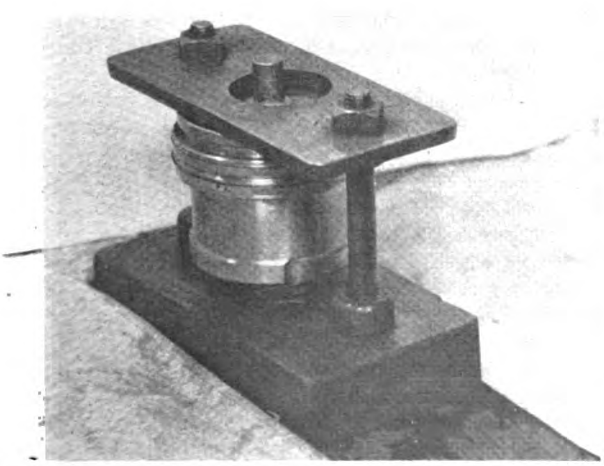


Fig. 1—Foot-operated device for dismantling and assembling AB brake valve accelerator release piston springs

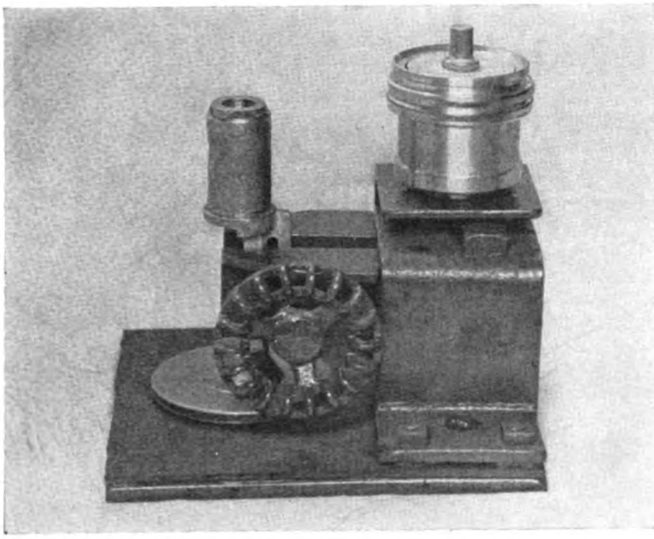


Fig. 4—Device for holding service and emergency pistons while removing or applying the piston-spring nut

In Fig. 3 is shown a very simple but convenient clamp for holding by-pass check valves, springs, seat and stop in place while applying the service-valve cover. This clamp is made of 3/32-in. by 1⅛-in. steel, bent to a U-shape with the upper leg (over the valve) 1⅞ in. long and the lower leg (under the valve body) 3⅝ in. long. The base of the U-clamp (shown vertical in the illustration) is 4½ in. long. By the use of this simple clamp an operation otherwise somewhat awkward to perform is easily handled.

An unusually convenient device, used for holding service and emergency pistons while removing or applying the piston-spring nut, is illustrated in Fig. 4. The top portion of this device is designed to suit the piston nut of the accelerator release piston. The method of using this device is clearly shown in the illustration and details of its design and construction are given in the drawing shown in Fig. 5.

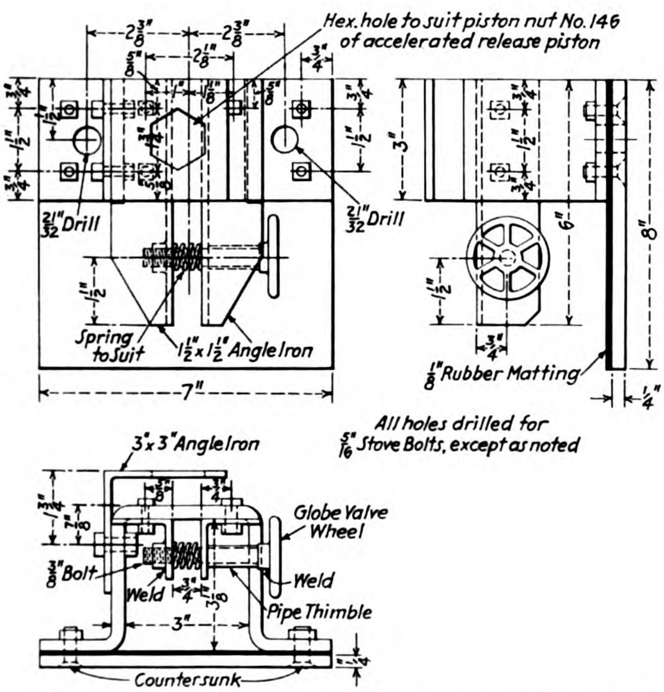


Fig. 5—Construction details of the service and emergency-piston holding device

An efficient device for cleaning the AB valve strainer is illustrated in Fig. 6, which shows details of construction of the device at the left and, at the right, how it looks after application of the strainer ready for testing. The manner of operating this device is as follows: Open the ½-in. cutout cock which permits air to be introduced into the inner cylinder of the strainer reversing the condition that caused the strainer to become clogged. Then open the ¼-in. pet cock which will cause the strainer to revolve at any desired speed by the action of an air jet on three vanes on the holding fixture underneath the strainer. Thus by centrifugal force any dirt loosened by the action of the air in the hub of the strainer will be ejected. If the strainer is in a very dirty condition best results can be obtained by soaking it for a short time in a cleaning fluid.

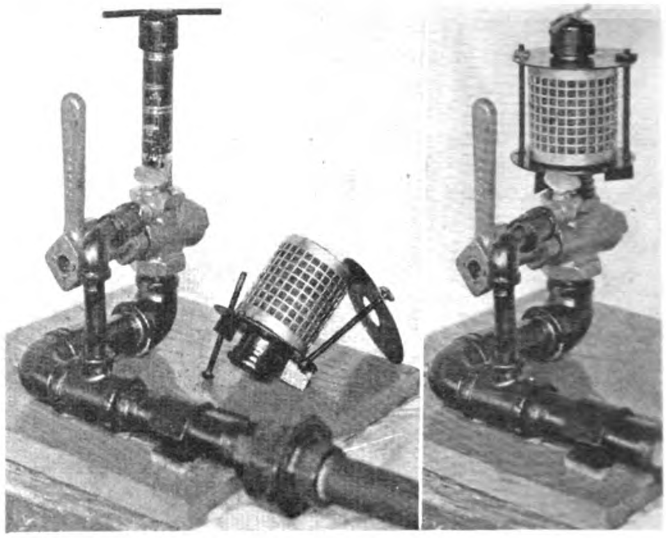


Fig. 6—Simple but effective device for cleaning the AB valve strainer by reversed air flow and centrifugal action

Rebuilding Gondolas At North Proviso

A series of 498 gondolas is now being completely rebuilt and reconstructed at the Chicago & North Western car repair yard, North Proviso, Ill., as shown in the illustrations. These gondolas, built in 1918, were of the composite, drop-bottom type with steel underframes, cast-steel side-frame trucks and a capacity of 100,000 lb. They are being converted to solid-bottom gondolas for coal, sand and gravel loading to meet the demands of shippers on the North Western lines, this type of material now being unloaded almost entirely with drop buckets. The coal formerly shipped in these cars, as equipped with bottom dump doors, is now handled for the most part in large-capacity hopper cars.

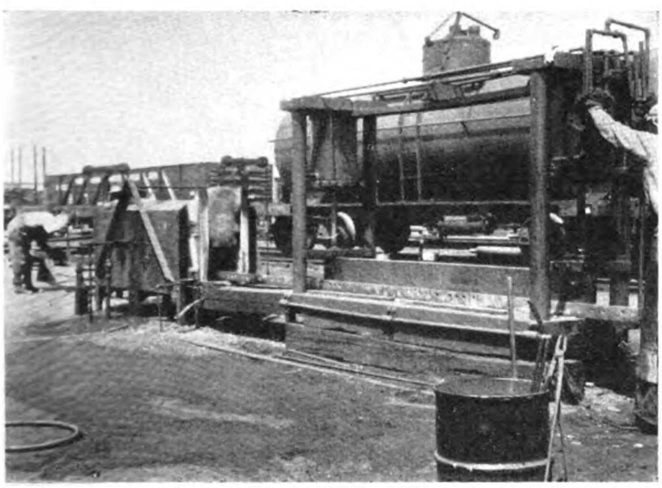
As indicated in the first illustration, the work of converting these cars is performed on two tracks with one standard-gage track and one narrow-gage track between for material-handling purposes. A Burro gasoline-engine-driven tractor with a 30-ft. boom is used on the standard-gage track for handling any scrap such as car sills and ends, and a lighter tractor, with necessary trailer equipment is used on the narrow-gage track for the speedy handling of lighter materials.

After a series of 12 of the old gondolas is set on the repair track at the left, the cars are completely dismantled and all corroded metal ends, side sills, bolsters,

Gondolas converted from drop to solid-bottom type at C. & N. W. car repair yard, North Proviso, Ill.

side posts and stakes are cut away with the acetylene torch, this scrap being set for loading on buggies and handled to the end of the yard. The skeleton car frames are then placed on repaired trucks and set on the track at the right for reassembling. Here the new steel parts are riveted in place and all other new material applied. The second illustration shows one of the finished cars which is the equivalent of a new car from a service standpoint and good for another period of use of six or eight years without any except very minor repairs. This conversion job is carried on with a production of three cars a day and a force of 61 men.

In order to handle the steel work in connection with these gondolas cars expeditiously and save as many steel sills, angles, shapes, etc., as possible for re-use in the converted cars, it was necessary to install two flanging presses and suitable furnaces at the North Proviso yard. One of these presses is illustrated. The cast-iron base plate, 3 ft. wide by 9 ft. long, is solidly mounted about 20 in. above the ground level. The corner posts are constructed of 4-in. pipe with suitable bolted tie rods extending through from the base plate to the top of two 15-in. channels which support two air cylinders 16 in. in outside diameter by 24 in. long. These air cylinders are equipped with pistons and piston rods, the lower ends of the latter being attached to a heavy horizontal steel die block which is guided in vertical movement by crossbars between the corner posts. Shop air, supplied at about 85 lb. pressure through the usual three-way operating valves, enables this press to be used effectively in straightening metal side plates, posts, braces and all metal parts which are reused in the construction of the cars.



Efficient furnace and flanging press at North Proviso

At the left of the press and about five ft. away from it is a brick-lined furnace 76-in. long and provided with a counter-weighted door at either end through which the long steel plates are passed and heated preliminary to the straightening operation. The furnace is arranged to burn oil and heat the steel parts sufficiently so that the steel may be straightened with ease. The furnace doors may be readily closed down on the steel so as to cover practically the 14-in. square opening at either end and thus minimize the loss of heat.

Another important labor-saving feature in connection with the use of this furnace and press is the provision, on either end, of four inclined steel rails, 12 ft. long, spaced about 8 ft. apart and mounted on posts 26 in. high at the outer end and 20 in. high at the lower end where roller supports are provided in line with the furnace and press. By the use of this equipment, the long

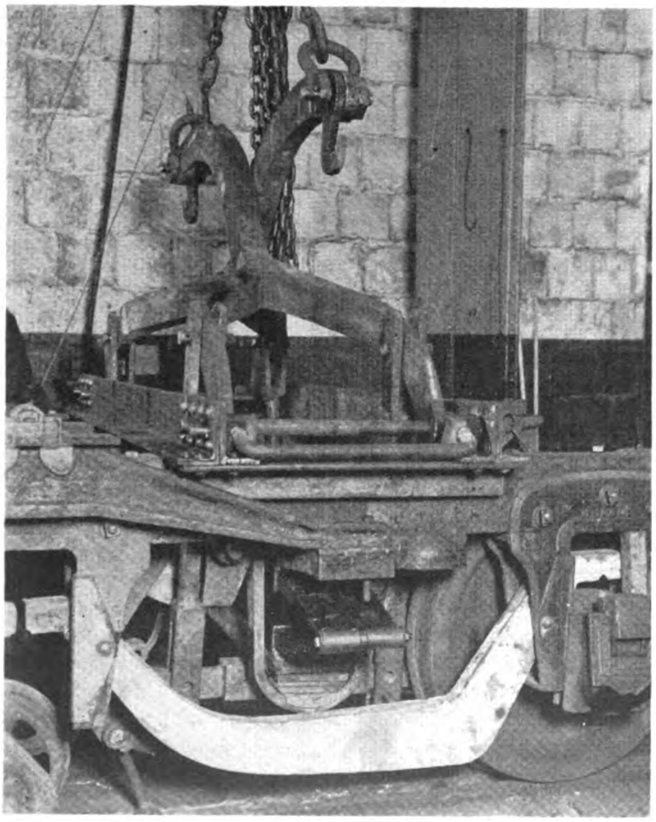
One of the C. & N. W. converted solid-bottom gondolas ready for service

and somewhat awkward steel shapes which require straightening may be handled with ease. They are simply placed on the inclined ways at the north end of the furnace, are then readily slid down to the rollers, worked through the furnace, straightened in the press and passed through onto similar rollers at the other end, from which they are moved up the inclined rails and subsequently handled by truck and trailer back to the cars where they are reassembled in position. Hammers are little used in connection with straightening steel shapes on this press, which is operated by two men.

Assembling Passenger Truck Springs

The equipment illustrated is used at the Decatur, Ill., shops of the Wabash, for compressing elliptic springs in passenger-car trucks, being patterned after a similar device used at the St. Louis-San Francisco shops, Springfield, Mo. Prior to the installation of this device it was necessary to compress these elliptic springs in a pneumatic press and clamp them together. Then in many cases the springs had to be compressed for removal by placing journal jacks under the spring plank. With the lever arrangement illustrated, connected to a suitable hoist, it is possible to remove and apply truck springs in less than one-half the time formerly required.

Separate operations for the removal or application of springs are not necessary, the entire job being done during the dismantling or assembling of the truck. At the time the springs are removed, for example, the wheels also are removed and the truck placed on dollies. It is then moved from under the stationary hoist and when the repairs are completed to the truck, it is brought back to the hoist where the new wheels are applied and the truck is then reassembled by reversing this operation.



Convenient jig used in removing or applying passenger-truck elliptic springs

All truck springs removed from the passenger cars as they go through the shop are given a bath in No-Ox-Ide in order to lubricate and condition them thoroughly for service. Two men perform this operation, that is, the removal of springs and wheels and assembling of the truck when it has been worked through the shop.

The hoist and spring compressor are located on a track leading directly to the wheel shop which avoids unnecessary handling of wheels in either direction. The device consists of a pair of heavy forged double-arm levers, secured by round fulcrum bars to a riveted steel base plate which rests on the truck frame. Vertical clevis bars extend downward to a rigid horizontal member under the spring plank and are pinned at the top to the lever arms a short distance above the fulcrum. With this construction it is evident that an upyard pull on the crane—in this case a stationary Ingersoll-Rand pneumatic hoist—will have the effect of holding down the truck frame while pulling up the spring plank. This permits disconnecting the spring-plank yoke and when the hoist and lever arms are lowered, the spring plank, elliptic springs, etc., may be readily removed. The reverse operation is followed in reapplying the springs.

Decisions of Arbitration Cases

(The Arbitration Committee of the A.A.R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Alteration of Billing Repair Card To Agree with Original Record

On April 29, 1935, at Stockton, Calif., the Western Pacific applied two new 33-in. cast-iron wheels of 80,000 lb. capacity to a Pacific Fruit Express refrigerator car and submitted a billing repair card which showed, due to a clerical error, that the wheels were mounted on an axle with a $6\frac{15}{16}$-in. wheel-seat diameter, ($\frac{7}{16}$ in. in excess of the standard dimension) instead of the correct dimension of $6\frac{5}{16}$ in. The wheel exchange was made because of a car owner's defect and the charge for new wheels, less scrap credit, was included in the repair bill.

The car owner checked the bill and passed it for payment, but returned the billing repair card and wheel statement to the railroad, requesting that the charge for new wheels mounted on the axle with an oversize wheel seat be reduced in accordance with fifth interpretation of A.A.R. Interchange Rule 98. The owner contended that the axle dimensions shown on the billing papers should be carefully checked with authentic documents, according to Supplementary Regulations and Arbitration Decision 1722, prior to rendition of the bill and that the dimensions recorded on the wheel and axle statement cannot be changed to conform to charges made after the bill has been checked and approved for payment by the car owner.

The Western Pacific stated that the wheel record written at the car at the time the wheels were applied showed the wheel-seat diameter as $6\frac{5}{16}$ in. and that this serves the railroad as its original record rather than the carbon copy of the wheel slip attached to the billing repair card. It was pointed out that in writing the billing repair card from this original record a clerical error was

made showing the wheel seat diameter as $6^{15}\!/_{16}$ in. instead of $6^{9}\!/_{16}$ in. and that the original record was not changed to conform with the billing. The Western Pacific maintained where no change in the original record is involved, the billing repair card may be corrected after the bill has been rendered.

In rendering a decision, the Arbitration Committee stated: "Decisions 1202 and 1452 are parallel, as the change in axle dimensions made on billing repair card after the bill had been rendered, was due to a clerical error in transcribing from original record taken at the car to the billing repair card. Decision 1722 does not apply, as that case involved a difference between dimensions shown on the original record taken at the car and wheel-shop records. The contention of the Western Pacific is sustained."—*Case 1749, Pacific Fruit Express versus Western Pacific.*

Alloy-Steel Gas-Welding Rod

The Air Reduction Sales Company, New York, has developed a gas-welding rod designed to meet the demand for increased ductility and general improvement in quality of both single and multi-layer steel welds. A feature of the Airco No. 1 high-ductility alloy-steel rod, as it is designated, is its ability to withstand considerable heating without burning. It is reported that tests have shown it to be ideal for all steel pipe and plate welding, both light and heavy.

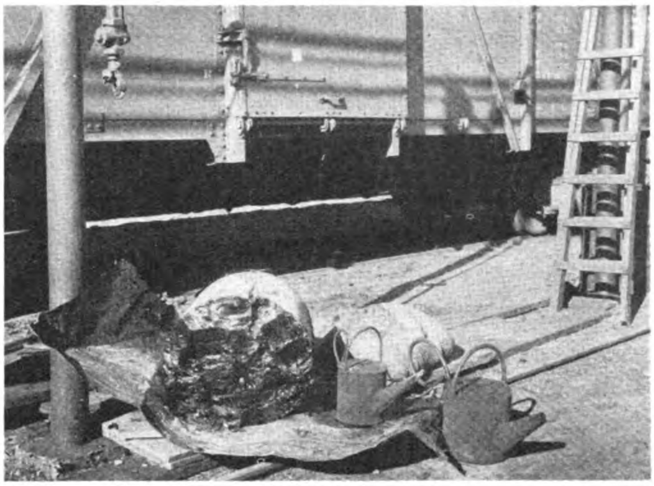
Following are some of the reported physical characteristics of welds made with this rod: Free bend ductilities of single-layer welds range from 20 per cent to 30 per cent depending upon the composition of the steel; free bend ductilities of multi-layer welds are as high as 40 per cent on low- and medium-carbon steels; the welds have ultimate tensile strengths in excess of 60,000 lb. per sq. in.; the specific gravity of welds range from 7.80 to 7.86; Charpy impact values on keyhole notched specimens at 70 deg. F., range from 15 to 30 ft.-lb.; and Rockwell hardness of the weld metal ranges from B60 to B85, depending on carbon content of the base metal and the type of weld.

Making Box-Car Floors Tight

Box car floors which have been in service for some time frequently develop slight cracks due to shrinkage or other cause, thus making the cars unfit for loading bulk commodities such as grain, cement, etc. To permit tightening the floors without the renewal of floor boards, either in part or in full, the equipment and method shown in the illustrations is now being successfully used by the Minneapolis, St. Paul, & Sault Ste. Marie at its main car-repair shops, Minneapolis, Minn.

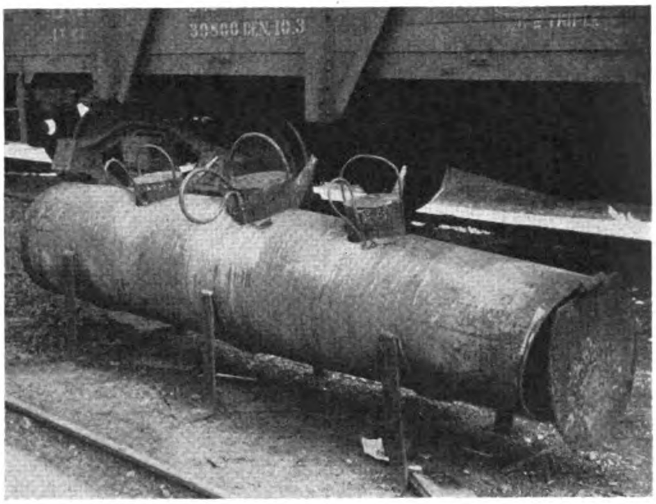
The method consists simply of cleaning out the cracks with a narrow steel hook, sweeping the floor clean and filling all cracks with a hot waterproofing, or sealing compound which, when cool, makes the floor tight and suitable for any lading. In case the cracks are fairly large, nailing strips are applied underneath the car floor to hold the water-proofing compound until it has had a chance to solidify. Shavings are applied in some of the larger cracks to avoid using an excessive amount of compound. Fine shavings are also sprinkled over the compound while the latter is still hot, thus becoming imbedded in it and giving the cracks a more uniform appearance with the rest of the car floor.

The particular compound used in these cars is black in color, odorless and sets quickly. It is known as Group 12 car water-proofing compound. It is received in 400-lb. metal drums which are cut away so that the



Water-proofing compound as received in 400-lb. metal drums

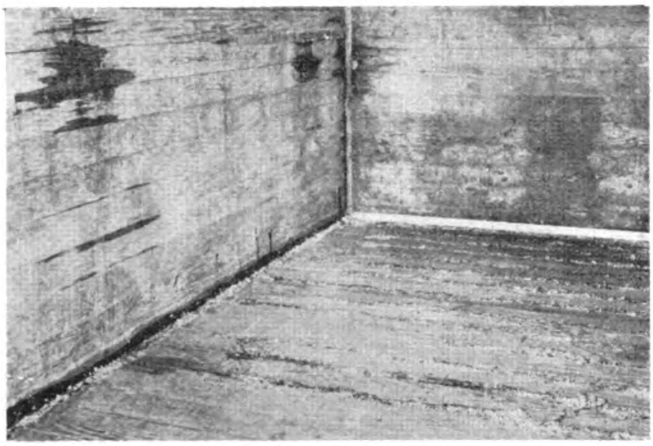
compound may be readily broken into small pieces and placed in heating pots in a shop-made heater shown in one of the illustrations. This heater consists of a scrap Pintsch gas reservoir in which three round holes have been cut in the top to accommodate two small and one



Scrap Pintsch gas reservoir fitted up with heating pots for keeping the water-proofing compound hot

large heating pots. Scrap wood is burned in this heater, the ends of the heater being covered with a vertical swinging hinged door for use when necessary to regulate the draft. The heater is easily portable and may be placed wherever most convenient for the work in hand.

Referring to the illustration, the compound is heated in the largest pot in the center, the other two smaller pots being used to pour compound into the cracks after they have been cleaned out with a steel hook, as mentioned. The temperature range must be held fairly close as the compound will not pour if too cold and it has a tendency to boil up out of the cracks if poured too hot. In addition to filling cracks in the floor, as shown in another illustration, this compound is used at the junction



One corner of a car in which floor-board and corner cracks have been made tight by use of water-proofing compound

of the floor and the sides and ends, or, in fact, wherever cracks exist. In some cases corner strips are applied and nailed in place while the compound is still hot thus assuring tight joints inaccessible to grain weevils and other insects.

Questions and Answers On the AB Brake

Operation of the Equipment (Continued)

213—*Q.—What change in pressure ensues in the chamber at the left of the accelerated release piston?* A.—Movement of the emergency slide valve to the emergency position cuts off this chamber from the quick-action chambers and establishes connection to the emergency reservoir, which is also the brake cylinder pressure at this time.

214—*Q.—What resultant movement of the accelerated release piston ensues, and why?* A.—The piston is moved to the right, due to the fact that the quick-action chamber air pressure on the right is reduced to zero and the emergency reservoir pressure is on the left.

215—*Q.—What is the rate of the exhaust of the quick-action chamber air to the atmosphere and what happens when the pressure is reduced to a certain value?* A.—It is such that the vent valve will remain open about 60 or 70 sec. When the pressure is reduced to the required value, the vent valve spring forces the valve to its seat.

216—*Q.—What is the purpose of this arrangement?* A.—First, to insure transmission of quick action; second, to prevent the release of an emergency brake application before the train is at rest; and third, to insure that the brake-pipe pressure can be restored when this is so desired.

217—*Q.—When the brake-pipe pressure is restored on the face of the emergency piston following an emergency application, does the piston return to the release position?* A.—No.

218—*Q.—What is the reason?* A.—As previously explained, the accelerated release piston was moved to the right during the preceding emergency application.

219—*Q.—What is the result of this movement?* A.—The emergency spring guide comes in contact with the accelerated release piston stem, thereby arresting further movement of the emergency piston.

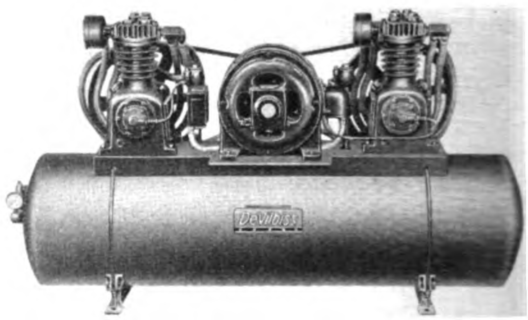
220—*Q.—How long does this condition exist?* A.—Until approximately 20 lb. pressure has been built up on the face of the emergency piston.

221—*Q.—How does this amount of pressure bring about a change in the position of the parts?* A.—This pressure is sufficient to compress the accelerated release piston springs, with the result that the emergency piston and the slide valve start to move toward the release position.

Small Air Compressor For Shops and Terminals

The DeVilbiss Company, Toledo, Ohio, has added to its line of products four small air-compressors with either 7½- or 10-hp. motors and with single- or two-stage compressors available with either horsepower. These compressors are designed especially for use where compressed-air requirements are unusually heavy, and for small shops and terminal plants where compressed-air needs are beyond the capacity of the ordinary air-cooled compressor but not equal to the capacity of the industrial-type water-cooled compressor.

The unit includes two compressors, each developing a maximum pressure of 200 lb. per sq. in., with the two-stage compressors, or 150 lb. per sq. in. with the single-stage compressor, mounted on opposite ends of a 20-in. by 60-in. air tank. The motor driving both compressors



This DeVilbiss 10-hp. air compressor mounted on a 20-in. by 72-in. tank has a displacement of 37½ to 57 cu. ft. of free air per min.

is set between them on the air tank. Each compressor has a V-belt drive, combination air strainer and muffler, check valve, inter-cooler and after-cooler, and a centrifugal pressure-release mechanism set to cut in at 160 lb. and to cut out at 200 lb. on the two-stage unit; on the single-stage compressor the mechanism cuts in at 80 lb. and cuts out at 100 lb. The air displacement of the units varies from 31½ to 57 cu. ft. of free air per min., depending upon pressure and horsepower. The air-tank capacity of both 7½- and 10-hp. units is 10.88 cu. ft., although a 20-in. by 72-in. tank with an air capacity of 13.06 cu. ft. is available. Standard equipment on all units includes a pressure gage, outlet, drain and safety valves, and an automatic starting device.

Lightweight Inspector's Lantern—A Correction

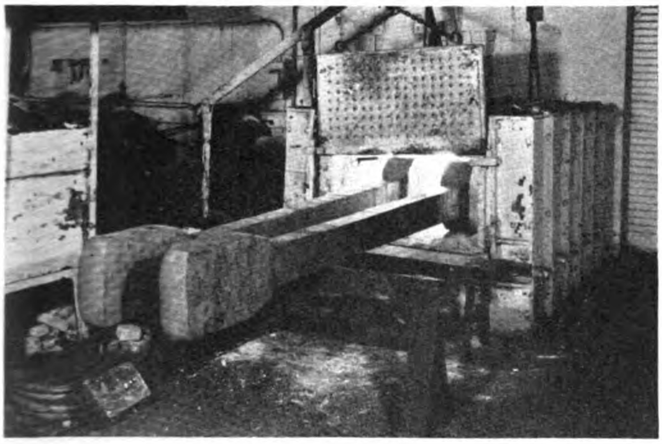
In a description of the National Carbide NJ-1 inspectors lantern, described on page 375 of the August issue, it was erroneously stated that its weight was 6 lb. The actual weight of this lamp is slightly less than 3 lb.

IN THE BACK SHOP AND ENGINEHOUSE

Machine Gas Cutting In Railroad Shops*

Machine gas cutting, the application of the gas-cutting process to the production of shapes from rolled-steel slabs, plates and rough forgings with torches supported and guided by machines as distinguished from hand-torch cutting, is as universal a tool as a hammer, and as important as a drill press or a lathe in its applications. Although this process is a known quantity, many questions arise as to its uses: What metals can be cut? What effect has gas cutting on the metal? What are the limitations as to thickness? What degree of accuracy can be obtained? Are specially trained operators required? What are the cutting speeds? Can production costs be predetermined and how do they compare with present practice? What will be the quality of the work?

Practically all classes of iron and steel in use in railroad work may be machine gas cut. Most ferrous metals can be flame cut. Steels under 0.30 per cent carbon can be cut cold, or without heat-treatment before



Preheating main rods for gas cutting

or after cutting. Machine gas cutting of these steels is just as well standardized and just as much a matter of course as their shaping by any of the older accepted machining methods. Steels in the higher alloy group can also be cut without difficulty. These steels, however, should be preheated before cutting and annealed afterward. When this procedure is followed, there is no more of a problem than when cutting the lower-carbon steels.

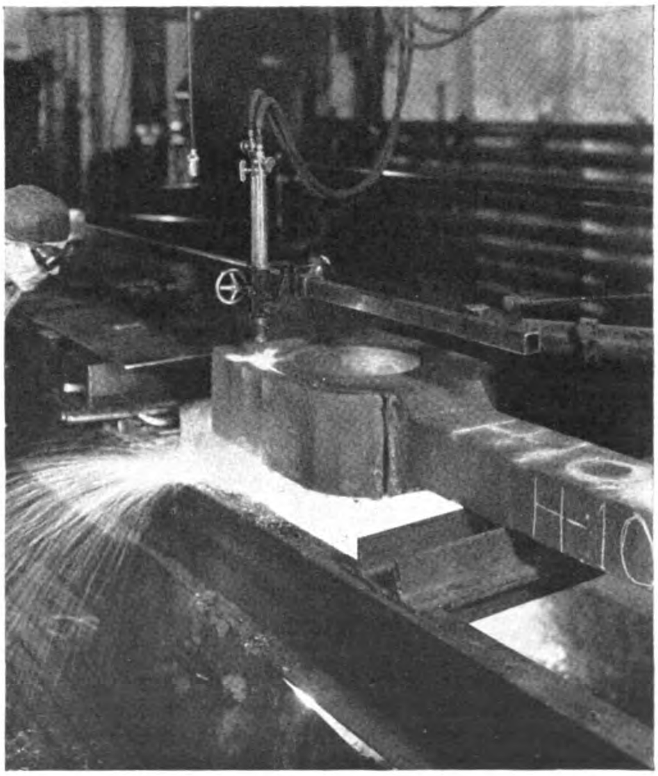
Flame cutting has no appreciable effect on the physical and chemical characteristics of the plain low-carbon steels which constitute the bulk of steels used on the railroads. That is why these steels are cut cold and need no heat-treatment, except in the case of large forgings which should be annealed and cut hot because of the strains inherent in them.

Steels over 0.30 per cent carbon tend to have some migration of carbon to the flame-cut surface. When correct practice is followed and these steels are preheated before cutting and annealed afterward, they are just as easy to cut as the lower-carbon steels and can be machined afterward without difficulty. The annealing returns the steel to practically its original state. Extensive researches and tests, both in this country and abroad, have established this fact beyond a doubt.

Bear in mind that where machining or grinding operations are performed after cutting, the comparatively small affected area is completely removed. This points out that there need be no concern about the effect of flame cutting on the metal. All plate and forging thicknesses common to railroads offer no difficulties whatever to the machine gas-cutting process. The oxyacetylene torch readily and smoothly severs sections far beyond the practical range of cutting by mechanical means.

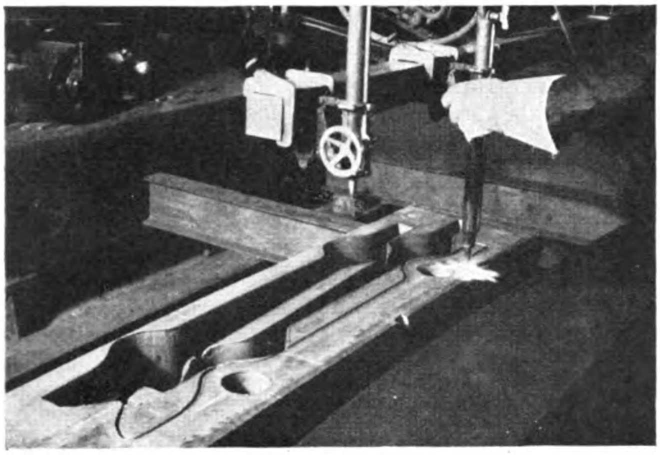
Flame cutting can be relied on for reasonable accuracy. The squareness and clean finish of such cuts, together with the sharp top and bottom edges, compare favorably with rough machining. The degree of accuracy depends largely on the grade and thickness of the material and the intricacy of the shape. Where no subsequent machine finish is required, ordinary steel plate generally may be cut right to the finish line. On the higher-carbon steels and parts which are to be machine finished, only a sufficient tolerance need be left to allow for easy and economical machining. Since tolerance varies with the grade of work to be done; it may be readily compensated for by making due allowance on the drawing template or cam used in cutting the shapes. The kerf, or width of the cut, is taken care of the same as tolerance. The allowance is no more than would be made with other methods.

The question of getting good operators presents no unusual difficulties. Any shop man of average intelligence and ability can learn to operate a flame-cutting

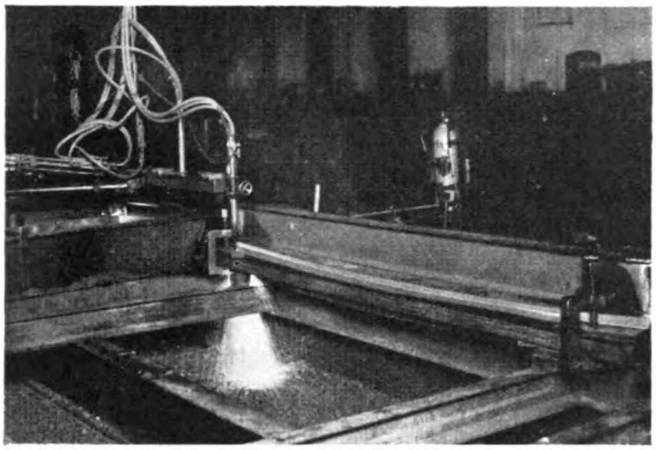


Trimming the back end of a main rod with a gas cutting machine

* Abstract of paper presented by R. F. Helmkamp, machine gas cutting specialist, Air Reduction Sales Company, before the Southern & Southwestern Railway Club, Atlanta, Ga., May 20, 1937.



Cutting locomotive cross equalizers from a steel slab



Machine gas cutting of a stack of 3/32 in. steel plates

machine. Simply follow the instructions furnished with each machine, make the recommended adjustments to suit the thickness to be cut, as given in set-up tables, and the rest is largely automatic. With the proper procedure you get good results, and get them economically.

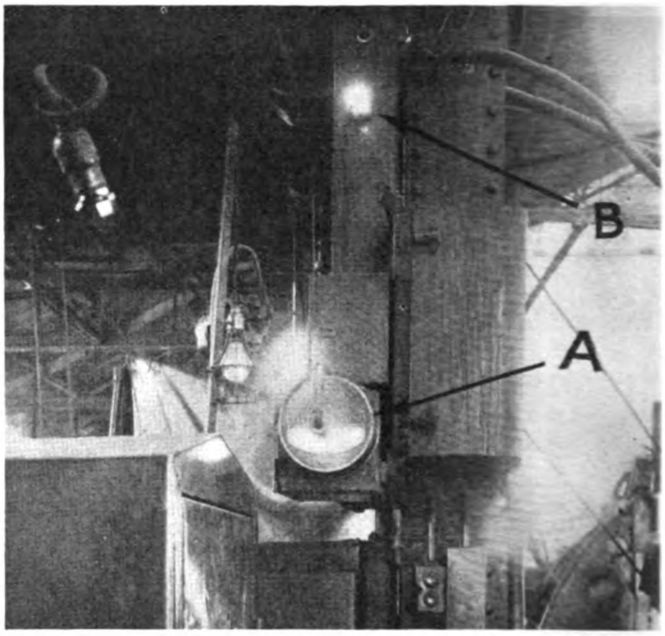
Cutting speeds and gas-consumption costs are items that vary, depending on the kind of steel, thickness, intricacy of the contour, the quality of finish desired, etc. Reliable set-up and gas-consumption tables are furnished, covering steel up to 12 in. thick or more. Reference to these tables provides reliable estimates on gas consumption and cost as well as the actual cutting time. Tip sizes and gas pressures are shown which represent good practice.

The process is not experimental; it has an enviable background in up-to-date industry and especially in the heavy industries. The present stage of dependability and usefulness is the result of earnest effort to put to use a process that has progressed beyond the laboratory stage, and proved its advantages over a period of time.

Accurately Balanced Quartering Machine

Having experienced some difficulty in securing the desired degree of accuracy in turning locomotive journals in the journal-turning and quartering machine at the Northern Pacific locomotive shops, Brainerd, Minn., it developed that the difficulty was primarily due to an unbalanced condition in the machine which was corrected by application of the ingenious special equipment shown in the illustration. The use of this device not only assists the lathe operator in determining when the machine is well balanced and, therefore, capable of doing accurate work, but this condition is made evident by means of an indicating light to the foreman or any one interested who may be passing up or down the shop.

Balancing equipment included on the combination journal-turning and quartering machine, shown in the illustration, consists of one static and two adjustable counterweights, but it is difficult to get an accurate balance on all types and conditions of driving wheels and, if not balanced, the journals are likely to be turned more or less out of round. To remedy this condition, a sensitive ammeter *A* is installed which, within the limited range of power required for turning journals and assuming constant voltage, reflects very accurately the electric power supply to the driving motor. Even minor fluctuations in power input to the motor during each revolution of the driving wheels are, therefore, indicated by the pointer on this ammeter. A small shielded electric light is located just in front of the ammeter dial, part of which is blanked by a segment of dark paper with a narrow vertical slot opening, this paper being pasted on the ammeter cover glass. A photo-electric cell is located behind the ammeter dial in such a way that whenever the



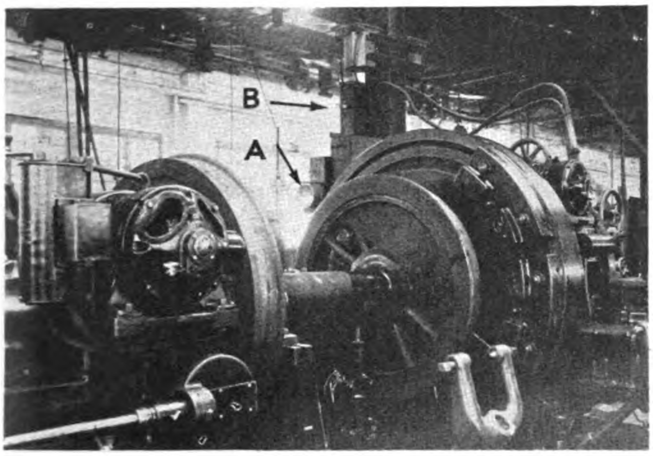
The sensitive ammeter *A*, photo-electric cell and lamp *B* which gives intermittent light when the quartering machine is out of balance

pointer passes the slot and interrupts the ray of light, a second electric light *B* is caused to burn, thus indicating that the current input to the driving motor is fluctuating and that the load is unbalanced. Light *B* is located on one of the shop posts where it may be readily seen.

In using this device, the counterweights on the machine are adjusted until the power input to the motor, as indicated by the ammeter, is practically constant throughout the entire revolution of the driving wheel. When this condition is obtained the pointer is usually located within a limited range on one side or the other of the slotted opening, and the indicating light *B* remains dark. should the pointer happen to cover the slotted opening and remain in that position, light *B* would, of course, burn steadily but not thereby indicate a lack of balance.

If the lathe is not properly balanced in the first place, or if an unbalanced condition develops subsequently, the pointer passes back and forth over the slotted opening and an intermittent light shows at *B*. With lighter work or a smaller cut on the machine, less power is required, in which case the pointer occupies a different position on the dial, but the beam remains interrupted, and light *B* stays dark until such time as lack of machine balance and a fluctuating ammeter pointer cause it to burn again.

The demand for greater accuracy in most departments of locomotive repair work is accentuated by



Locomotive journal-turning and quartering machine equipped to give light indication when out of balance

modern high operating speeds, and driving wheels and axles are now receiving more attention than ever before. The method described furnishes an interesting illustration of the ingenious means adopted at one shop to assure accurate machine balance when turning locomotive driving journals and thus eliminate one cause of out-of-round and improperly finished journals.

Safe-Ending Flues by the Electric-Resistance Process

By H. A. Woofter*

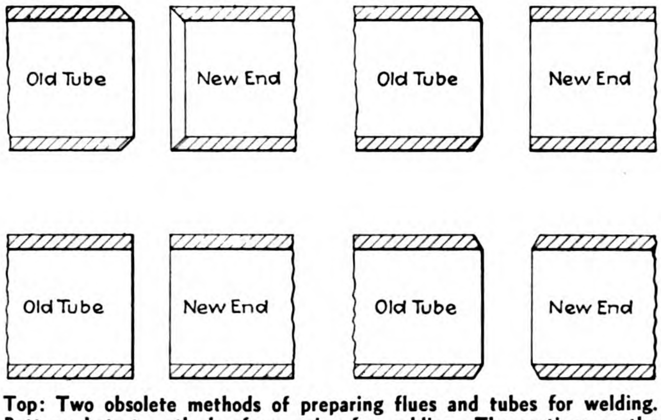
When a locomotive is in service, the flues and tubes oxidize and pit rapidly, especially at or near their junction with the front and rear tube sheets, and it is necessary to remove them occasionally to add safe ends from 8 in. to 12 in. long. This has to be done in some districts as often as every eight months if treated feedwater is not used, while in other sections of the country, where the feedwater is purer, the tubes will last from eighteen months to three years without attention.

Until recent years it was the time-honored custom to heat the ends of the safe end and flue in a gas or oil furnace, swage down the end of the old flue, expand the end of the new piece to be added, then force the new end over the old flue in the manner of a scarf joint and hammer the pieces together in a weld by means of a pneumatic hammer. The rejected or imperfect welds sometimes ran as high as 30 per cent; furthermore, the production was limited to a small number of flues per hour for two men.

In 1912 the Norfolk & Western installed an electric welder for this class of work, followed in a few years by the Nashville, Chattanooga and St. Louis, and a few others. Within the last 12 years more than half of the railroads of the United States and Canada have installed resistance welders in their shops. Users were urged at first to scarf the ends of the flues and safe ends in a lathe before attempting to make electric welds. Also, they were cautioned to machine the pieces very accurately so as to obtain practically perfect contact before attempting to weld. However, this order has changed with the advent of better flue welders and today it is neither necessary to scarf the ends of the flues or safe ends, nor to do any lathe or other machine work, because better clamping devices, dies and more uniform distribution of the current to the work are now available. The flues may be either sawed or cut by an ordinary disc cutter or pipe mill.

The latest type of flue welder burns off about ¼ in. of each piece of the work, so that inequalities of surface are in this way eliminated; however, it is essential to have a properly designed, modern welder. Early flue welders were of the butt type only and required nearly a perfect fit between faces of the work. One of the illustrations shows obsolete and modern methods of preparing flues and safe ends for the welder.

The present practice, or routine, in the most up-to-date railroad shops is about as follows: The old flues and tubes taken from the locomotives are tumbled or rattled for a number of hours inside a revolving drum, where hot water, steam and sometimes certain chemicals are placed to remove rust and scale. The damaged ends are then cut off in a pipe mill or pipe cutter, after which they are ready for new safe ends. If, however, the rattler has not completely removed the scale or rust from the ends, or if they have rusted while in storage, it is well to have a sandpaper belt machine at hand so that they may be pressed against the belt for three or four seconds to clean the end which goes into the electrodes of the welder. The safe ends, ordinarily, do not require cleaning. If, however, they are rusty they also may be cleaned against the sand paper belt. Clean work greatly lengthens the life and eliminates frequent cleaning of the dies. The flue and safe end are then clamped in the welder by means of quick-acting air cylinders. The weld is made in the period of a few seconds by the flash process. The vicinity of the weld is then heated a little more and mechanical pressure applied so as to make a slight upset, or swelling, in the vicinity of the weld so that it will go over a mandrel.



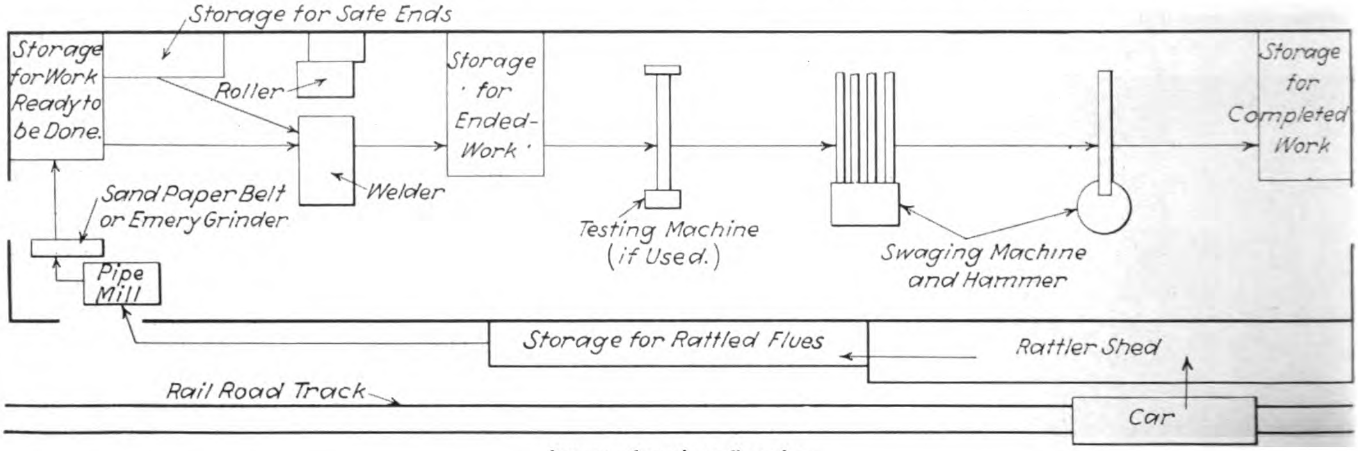
Top: Two obsolete methods of preparing flues and tubes for welding. Bottom: Latest methods of preparing for welding—The sections on the left were sawed or cut in a pipe mill, while the two at the right were parted by a disc cutter

The flue is immediately unclamped and shoved quickly over the mandrel with three revolving rollers, which roll down the upset. An improved method for rolling flues,

* Chief Engineer, Federal Machine and Welder Company, Warren, Ohio.

which eliminates the ridge on the inside diameter caused by rolling in the slag formed during the flash period, was described on page 319 of the July, 1937, issue of the *Railway Mechanical Engineer.*

The practice formerly was to test each weld, either by means of steam or air pressure, at the same time striking the flue several hard blows with a hammer; soap suds were used to indicate leaks. However, a leak was found so rarely that many up-to-date shops no longer test the flues in any manner, but install them directly in the locomotives. Flues are sometimes safe-ended by this method as many as ten or twelve successive times. It is the practice in some cases to reclaim good portions of old flues by welding them together and then add a safe end. A typical layout of a modern flue shop is shown in one of the illustrations.



Layout of modern flue shop

It has been found possible to take care of the flues and tubes of from 1,000 to 1,200 locomotives in one welding machine, by operating it day and night. However, it is better practice to have two welders in an average-sized shop; one of these is usually a small welder of about 60- to 100-kva capacity to weld the flues from 2 in. to 3 in. inclusive, while the other is usually a larger welder of 200-kva capacity for welding superheater tubes. It is possible to take care of all sizes of tubes and flues on one larger welder, but it is necessary to change the copper dies to suit the particular diameter of the work.

Modern electric-resistance flue welders are absolutely flash proof, thus insuring long life to the windings and bearings. All moving surfaces slide on hardened and ground steel plates, thus assuring perfect alignment. The clamping device is especially improved over any that has previously been available, assuring long life through its protection from slag, as well as a uniform distribution of current around the circumference of the work. The following four types of pressure devices are available: (1) A hand toggle, which gives the operator perfect control of his work at all times; (2) hydraulic pressure from an accumulator or pump; (3) an oil gear, or similar device; and (4) a hand-operated oil jack, which is considered obsolete.

In comparing the total cost of welding flues by the electric-resistance process and the oil-forge process, the author has observed that, with a relatively old-type resistance welder, 700 flues of 2 in. diameter can be welded in 10 hr. at a cost of 1.04 cents per weld, whereas by the oil-forge process only 370 flues of 2 in. diameter can be welded in 10 hr. at a cost of 3.54 cents per weld. In one shop where 80 superheater tubes of 5-3/8 in. diameter were being safe ended in a 10-hr. day, it was observed that the cost per weld was 4.92 cents. The author noted with interest while obtaining the foregoing figures that the flues and tubes electrically welded were perfect, but that 30 per cent of the flues welded by the oil-forge process were found defective. While safe ending 2-in., 3-in., 4-in. and 5-3/8 in. flues and tubes with a relatively old electric-resistance welder, the cost of making 1,000 welds at 1 cent per kw.-hr. was approximately $1.25, $1.75, $3.00 and $5.00, respectively. The foregoing costs would undoubtedly be reduced if they were based on welds made by welders of modern design.

About twelve years ago one railroad made up a test flue by welding together ten pieces of boiler flues 2 in. in diameter by 8 in. long. This sample flue was then bent cold around a 20-in. diameter mandrel and subjected to a water-pressure test. There were no leaks, creasing or buckling. This test showed that the welds were at least 100 per cent as strong as the original flue, the pressure and rolling having refined the grain of the metal at and near the weld.

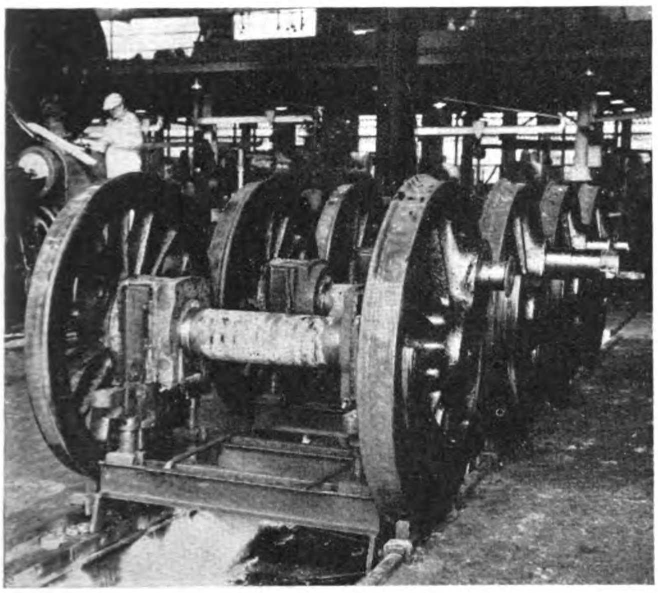
Wheeling Locomotives In 15 Minutes

When any statement is made regarding an unusually short time required for wheeling locomotives, the implication to experienced shopmen is that all preparatory


Wheel-positioning V-blocks and binder supports used in the quick wheeling of a steam locomotive

work, in so far as possible, is done in advance, and the concluding operations of tightening binders, setting up wedges, applying brake rigging, etc., are not included in the wheeling time. In other words, the wheeling time is considered to comprise only the interval of time during which the locomotive is lifted by the shop crane from its blocks in the erecting shop and placed on its own wheels over the wheeling pit, with the driving boxes, shoes and wedges in place and the binders applied. On this basis, and using the equipment shown in the illustration, it is possible to wheel a locomotive complete in from 12 to 18 min., and, while the wheel-centering and binder-supporting arrangement are not especially new, the design is unusually simple and rugged, and, therefore, worthy of consideration for use in shops less well equipped.

The equipment required in wheeling a four-coupled locomotive is shown in the largest illustration. The driving-wheel positions and spacings are accurately laid out in advance on the wheeling-pit tracks and the wedge blocks are applied and clamped to the rail as illustrated. Substantial welded steel cross beams, two per pair of wheels are applied across the pit on which are placed heavy 3-in. jacking screws provided to support the binders. These cross beams and binders also are

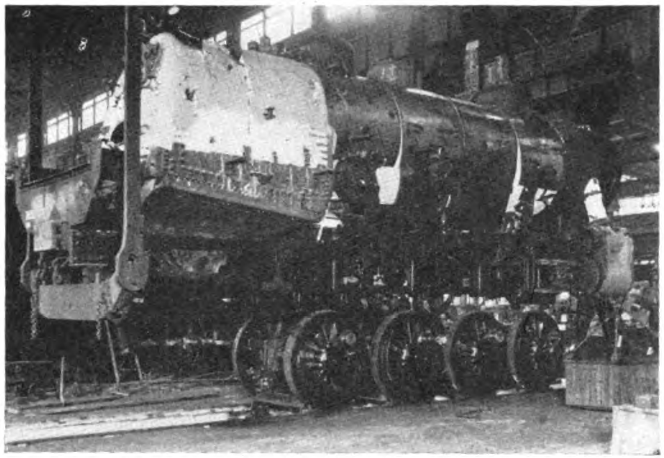


Driving wheels in position over the V-blocks, with binders up against the driving boxes

centered accurately with respect to the driving wheels, so that when the locomotive is lowered over the wheels the pedestal jaws will be accurately positioned over the corresponding slots in the binders. It will be noted from the same illustration that the wedge bolts also are in place.

The next operation in wheeling the locomotive is to set each pair of wheels, with driving boxes in place, in proper position on the wheeling track as determined by the V-blocks. Care should be exercised to have all crank pins in the same angular position, and, in some instances, it may be advisable to apply the side rods before wheeling. Referring to the second illustration, it will be noted that the jacking screws are set up so as to bring the binders nearly up to the driving boxes, and the wedges are applied in the driving box shoe-and-wedge ways. The shoes are bolted to the frame pedestals and come over with the locomotive in accordance with the usual practice.

A preliminary coating of lubricant is usually applied to the shoes and wedges and, when the locomotive is brought over by the shop crane, as shown in the third illustration, it can usually be dropped without difficulty or loss of time until its weight rests on the driving boxes and wheels. The weight of the locomotive is utilized to force the pedestal jaws into the binders, so



The locomotive being lowered by the shop crane over the accurately positioned driving wheels, boxes and binders

that binder nuts may be easily run up on the bolts and require only a final tightening operation.

Like all well organized shop operations, this method of wheeling a locomotive saves many man-hours of labor. It is much easier to assemble the binders in place before the driving wheels are on the track and it is also easier to apply wedges and wedge bolts before the locomotive is dropped over the wheels. Moreover, with the wheels accurately positioned, it is no longer necessary to move wheels back and forth with a pinch bar, while several men in the wheeling gang are standing idle and waiting. Another important advantage, sometimes overlooked, is that, with a short time required for the actual wheeling operation, the shop cranes are held for only a limited period and quickly released for other important work about the shop.

Locomotive Boiler Questions and Answers

By George M. Davies

This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.

Causes of Scale and Foaming

Q.—Which impurities in water form the scale in a boiler and which cause foaming?—F. C.

A.—The calcium and magnesium bicarbonates and sulphates, and silica are usually classed as scale forming solid present in water. The carbonates will form scale in pipe lines, heaters, pumps, or tanks outside of the boiler, where temperatures are lower than when under the operating pressure of the boiler. Sulphates and silica as well as carbonates form scale in boilers. The sulphates and silica seldom form scale until they

reach the high temperature encountered in the boilers. Oil, or greases, also help to form scale in that they act as binders which cement together particles that might otherwise merely form sludge.

The carbonates will not always form scale but separate out as sludge or mud. However, this sludge or mud is very apt to bake on as scale.

There are three classes of impurities in water that cause foaming, namely certain types of suspended matter, dissolved solids and certain types of organic materials.

Finely divided suspended solids such as silt naturally present in the water or sludge thrown down by treatment and heat in the boiler, tend to cause foaming. The more finely divided or smaller the particles, the greater the effect on foaming.

All dissolved solids in sufficient quantity tend to cause foaming. However, they do not greatly affect foaming characteristics of water unless accompanied by finely divided solids or by organic materials. Very pure water that contains nothing but dissolved inorganic solids usually does not foam easily at concentrations ordinarily carried in boilers.

Certain organic materials such as lubricating oil, etc. greatly affect the foaming characteristics of water especially if there is much finely divided suspended material present.

Advantages of Locating Throttle in Smokebox

Q.—What advantages are gained by locating the throttle in the smokebox instead of in steam dome?—J. G.

A.—With the throttle located in the dome, the steam does not enter the dry pipe until after the throttle is opened, while with the throttle located in the smokebox, the dry pipe, superheater header and units are filled with steam at all times. Also, the available steam space of the boiler is materially increased when the throttle is located in the smokebox. The steam reaches the cylinders quicker than if the throttle were located in the steam dome, thereby making for easier starting and stopping of the locomotive.

The Slope of Crown Sheets

Q.—What amount is the front-to-back slope of crown sheets? —K. F. G.

A.—The slope of the crown sheets from the front to the back of locomotive fireboxes is generally ½ in. in 12 in. The exception would be a switching engine or a locomotive designed for severe grades.

Distance from Bottom Water-Gage Connection to the Crown Sheet

Q.—What is the usual distance from the bottom of the water-gage mounting to the crown sheet?—K. F. G.

A.—This question is answered in Rule 37 of the Interstate Commerce Commission of Locomotive Inspection, Laws, Rules and Instructions for Inspecting and Testing Steam Locomotives and Tenders and Their Appurtenances, which states:

"*Number and location.* Every boiler shall be equipped with at least one water glass and three gage cocks. The lowest gage cock and the lowest reading of the water glass shall be not less than 3 in. above the highest part of the crown sheet. Locomotives which are not now equipped with water glasses shall have them applied on or before July, 1912."

Relative to this question, page 291 of the A. S. M. E. Boiler Construction Code states in part:

"*Water Glasses and Gage Cocks.* Each boiler shall have at least one water gage glass, with connections not less than ½ in. pipe size. The lowest visible part of the water glass shall not be less than 2 in. above the lowest permissible water level. The water gage shall be equipped with a valved drain. The lowest permissible water level shall be that at which there will be no danger of overheating any part of the boiler when it is operated with the water not lower than that level. This level for the usual type of boilers is given in paragraph A-21 of the appendix." Paragraph A-21 of the appendix referred to in this paragraph contains among other information the following two statements relative fusible and steam-actuated plugs:

"Fire-actuated fusible plugs, if used, shall be located at the lowest permissible water level for different types of boilers as given below; steam-actuated plugs, if used, shall be so located that they will operate when the water level is at the point where a fire-actuated fusible plug would be located if installed under these rules."

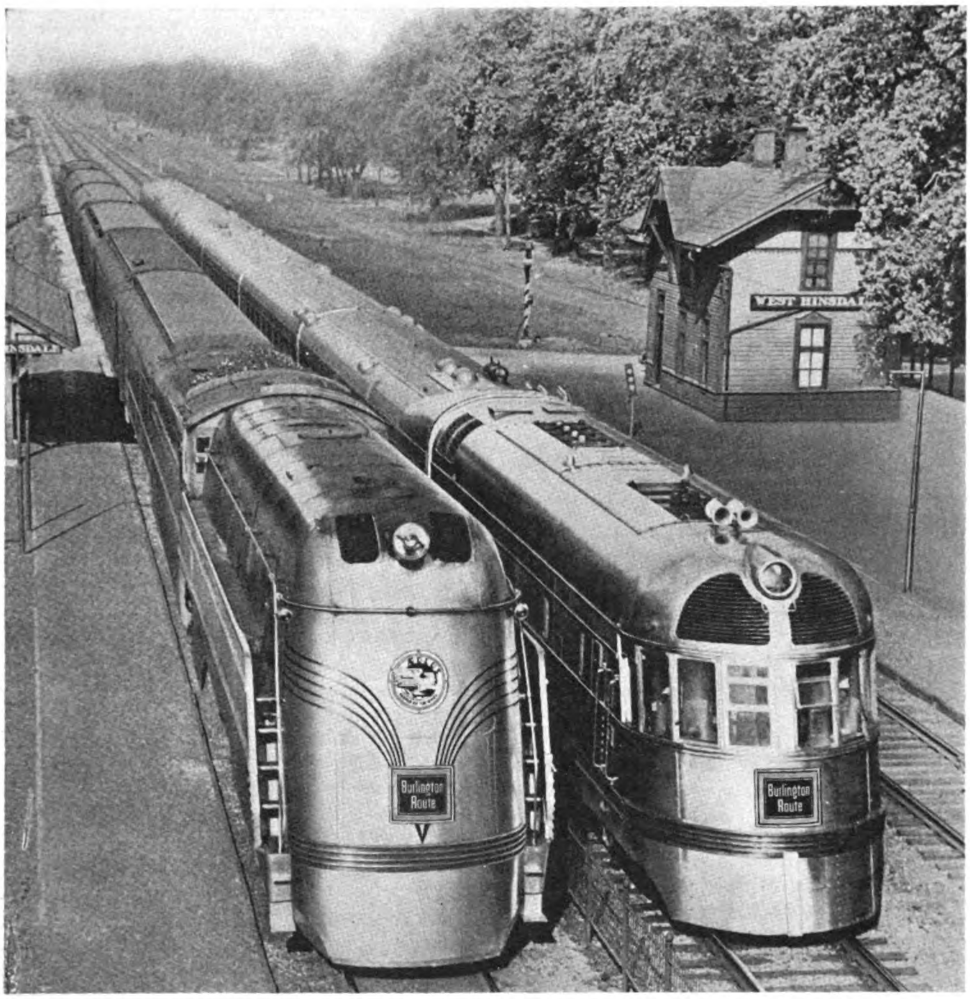
Carboloy Blanks Standardized

Three styles of standard Carboloy blanks available in 96 sizes have been designed for wide application by the Carboloy Company, Inc., Detroit, Mich., based upon experience with thousands of carbide-tool applications. They are adaptable for use on more than 90 per cent of all carbide tools in use today. In many cases, simple revisions in tool design will enable users to use these standard blanks at a substantial saving in carbide cost. These savings will apply to standard blanks used by

Three styles of Carboloy blanks available in 96 sizes

manufacturers in making their own tools, or used in Carboloy milled-and-brazed, or finished tools.

A number of advantages are said to result from the use of these Carboloy standard blanks: (1) Savings of 15 per cent and up on the price of Carboloy in any grade effected by quantity production of the tools; (2) large-quantity prices on small quantity orders; (3) immediate deliveries; (4) reduction in designing time and blank cost by using blanks shaped to proved tip proportions; and (5) wide adaptability offers users a chance to group purchases on larger quantities.



Aeolus coal-burning streamlined steam locomotive and conventional equipment, lined up beside one of the Twin City Zephyrs on the Burlington main line between Chicago and Aurora, Ill.

NEWS

A.A.R. Creates Research Division

ESTABLISHMENT by the Association of American Railroads of a Division of Engineering Research to expand and co-ordinate research work now being carried on by the railroads of the country in so far as it affects the physical properties was announced on August 11 by J. J. Pelley, President of the Association.

The Division of Engineering Research will have jurisdiction over all research relating to cars, locomotives, track structures, buildings, electrical, shop and maintenance of way equipment and the materials and supplies used in connection therewith. Not only will it deal with all mechanical facilities, but also with metallurgical and physical problems, as well as fuel, water, paints and other materials and supplies.

This new division will absorb the work now being performed by the Division of Equipment Research which was organized several years ago. L. W. Wallace, who has been head of the Equipment Research Division, has been appointed director of the Division of Engineering Research. G. M. Magee, assistant engineer of the Kansas City Southern, has been appointed assistant director.

The Division of Engineering Research will neither duplicate nor replace the activities of the test or research departments of the various railroads, but will be supplementary and complementary thereto. It will maintain the closest possible contact with the mechanical, civil, electrical, chemical and other technical offices of the railroads, the various divisions of the Association of American Railroads and all manufacturers who supply the railroads with equipment and materials.

Under the plan of organization, the Division of Engineering Research will be aided by two advisory committees. One will be the General Committee of the Mechanical Division of the Department of Operations and Maintenance, or an appropriate committee appointed by them, and will be designated as the Mechanical Research Advisory Committee. The other one will be the Engineering Research Advisory Committee composed of representatives of the Civil, Electrical and Signal Sections of the American Railway Engineering Association and the Engineering Division. In cases where both mechanical and civil engineering problems are involved, the committees will act jointly.

The headquarters of the Division of Engineering Research will be at 59 East Van Buren Street, Chicago, Ill.

L. W. Wallace was born at Webberville, Tex., on August 5, 1881, and graduated from the Agricultural and Mechanical College of Texas in June, 1903. During his summer vacation in 1901, he was a machinist helper in the locomotive repair shops of the International-Great Northern at Palestine, Tex. After leaving college, he served as a special apprentice on the Gulf, Colorado & Santa Fe and in September, 1906, became a member of the faculty in the mechanical engineering department at Purdue University, serving specifically as assistant in railway mechanical engineering. He also spent several

years as professor of railway and industrial management and was in charge of all railway mechanical work.

During his 11 years at Purdue, all of Mr. Wallace's summer vacations, except two, were spent in railroad work. His activities included work in car and locomotive design on the Missouri-Kansas-Texas; locomotive road tests and other experiments in the test department of the Atchison, Topeka & Santa Fe; association with Professor L. E. Endsley in tests for the American Steel Foundries with experimental track, relating to the frictional resistance due to sharp wheel flanges, and in comparative tests of rigid and flexible freight car trucks; preparation of instruction booklets for the Railway Educational Bureau; locomotive road and refrigerator car tests in association with Professor G. A. Young; road and laboratory tests with respect to the behavior of locomotive cinders, in co-operation with the Monon;

L. W. Wallace

and a series of standing tests at Purdue with large New York Central freight locomotives. While at Purdue he continued research on locomotive cinders.

From June, 1917, when he left the university, to March, 1919, he was assistant general manager of the Diamond Chain & Manufacturing Company, Indianapolis, Ind. He left that company to become director of the Red Cross Institute for the Blind at Baltimore, Md., and in January, 1921, became secretary of the American Engineering Council, then known as the Federated American Engineering Societies. He remained in this capacity until 1934, when he became vice-president of the W. S. Lee Engineering Corporation, in charge of its Washington office. In January, 1935, Mr. Wallace was selected as director of the Division of Equipment Research of the A.A.R., which position he held until his recent appointment. Purdue University conferred an honorary degree of Doctor of Engineering upon him in 1932.

G. M. Magee was born at New Hampton, Mo., on January 31, 1905, and was educated at Kansas State Teachers College, Pittsburg, Kan., and the University of Illinois where, in 1927, he completed a course in civil engineering. He entered railway service in 1924 as a chainman on the Kansas City Southern at Pittsburg, and in 1925 was granted a leave of absence to attend the University of Illinois. He returned to the Kansas City Southern in 1927 as a draftsman and subsequently was assigned to a study of the economic weight of rail. In 1931 he became assistant en-

G. M. Magee

gineer and in 1933 made track tests for the Carnegie-Illinois Steel Company and the American GEO Company, both here and in Germany. Upon his return to the Kansas City Southern in 1935 he served successively as chief draftsman and assistant engineer. Mr. Magee is active in the work of the American Railway Engineering Association.

B. & O. Capitol Limited Now Hauled by Diesels

THE 773-mile Washington, D. C.-Chicago run of the Baltimore & Ohio's Capitol Limited is now made in both directions with a Diesel-electric locomotive, the road having assigned its first two 3,600-hp. Diesels to that service. This, the B. & O. statement says, is the first time in eastern railroad territory that a long-distance train has been "powered in both directions by Diesel-electric drive." Two more of the 3,600-hp. Diesels will be delivered to the B. & O. within a few months.

Prior to the assignment of both to the Capitol Limited, one of the two Diesels hauled the Royal Blue on its daily round trips between Washington and New York, while the other went out of Washington at the head of the Capitol Limited every other day for the run to Chicago. One of these engines recently made "the longest non-stop run in eastern railroad history"—551.4 miles from Cincinnati, Ohio, to Washington.

Railway Pension Plan

THE labor-management compromise agreement on railway pensions recently embodied in law when President Roosevelt signed the Carriers' Taxing Act of 1937, brings about three major changes as compared with the enjoined law whereby the pension plan was split into two acts—one setting up the retirement plan and the other levying taxes to finance that plan. First, the new act sets up a permanent schedule of taxation. Second, there is the change in the tax rates. The new law sets up income taxes on employee earnings up to $300 a month, and an excise tax on carrier payrolls (with amounts paid over $300 a month also exempt) at the following rates: 1937, 1938 and 1939, 2¾ per cent; 1940, 1941 and 1942, 3 per cent; 1943, 1944 and 1945, 3¼ per cent; 1946, 1947 and 1948, 3½ per cent; 1949 and subsequently, 3¾ per cent. Finally, the scope of the tax act has been broadened so as to include, "in the capacity of employers groups . . . railroad associations, bureaus, and other joint agencies and the 21 standard railroad labor organizations."

The original tax act carried employee income and carrier excise tax rates of 3½ per cent. The estimated yield under the new rates is $121,000,000 for the fiscal year 1938, and thereafter increasing amounts up to the 1950 peak when the yield is expected to stabilize at $165,000,000.

President Roosevelt also signed on July 1 the joint resolution which carries for the fiscal year ended June 30, 1938, an appropriation to the railroad retirement account of $99,880,000 plus the account's unexpended balance of about $41,000,000. The Railroad Retirement Board is thus provided with funds for the administration of the pension plan.

I. C. C. Vacancy Filled By John L. Rogers

THE appointment of John L. Rogers of Tennessee to succeed Hugh M. Tate on the Interstate Commerce Commission was confirmed by the Senate on August 17. Mr. Rogers, who is 48 years old, came with the commission in 1917 as a mechan-

John L. Rogers

ical engineer in the Bureau of Locomotive Inspection. Since August, 1935, he had been chief of the Bureau of Motor Carriers of the commission.

The nomination of Joseph B. Eastman for a new term was confirmed on July 26. Both terms expire December 31, 1943.

Pullman Depreciation Rates Approved

THE Interstate Commerce Commission, Division 4, has approved rates at which the Pullman Company desires to charge off depreciation on its equipment. The rates were submitted in accordance with an order of the commission on May 18, 1936, and will apply, if the company so

(*Continued on next left-hand page*)

desires, from January 1, 1937, until they are further revised by the commission. The component percentage rates of depreciation are as follows:

General office buildings, 9.8 per cent; shops, 2.93 per cent; miscellaneous structures, 3.73 per cent; shop machinery, 3.85 per cent; standard sleeping cars, 3.79 per cent; tourist sleeping cars, 3.94 per cent; parlor cars, 3.86 per cent; composite cars, 3.7 per cent; private cars, 3.58 per cent; dining cars, 3.74 per cent; miscellaneous equipment, 7.02 per cent.

New Construction

The Minneapolis, St. Paul & Sault Ste. Marie has awarded a contract to Ernest M. Ganley & Co., Inc., Minneapolis, Minn., for the construction of an addition to its Shoreham shops enginehouse at Minneapolis, at a cost of about $30,000.

The Wabash has awarded a contract to the Cooper-Little Company, Detroit, Mich., for alteration work on its brick enginehouse at Delray, Mich., consisting of the construction of three new stalls and the extension of two existing stalls. A contract has also been awarded to Longwill-Scott, Inc., St. Louis, Mo., for the installation at Delray of a new 105-ft. three-point bearing turntable and for the removal of the 80-ft. turntable at that point. The latter contract also involves the construction of the concrete pit for the new turntable.

New Equipment Orders and Inquiries Announced Since the Closing of the August Issue

Locomotive Orders

Company	No. of locos.	Type of loco.	Builder
A. T. & S. F.	2*	Diesel-elec.	Baldwin Loco. Works
	3*	Diesel-elec.	American Loco. Co.
	6*	Diesel-elec.	Electro-Motive Corp.
C. R. I. & P.	1	Snow	....
Dominion Steel & Coal Co.	1	0-4-0	Montreal Loco. Works
Elgin, Joliet & Eastern	2	Diesel-elec.	American Loco. Co.
	5	Diesel-elec.	Electro-Motive Corp.
Jones & Laughlin Steel Corp.	1	0-4-0	American Loco. Co.
Minneapolis & St. Louis	2	Snow plows	Russell Snow Plow Co.
Northern Pacific	1	Rotary snow plow	American Loco. Co.
Patapsco & Back Rivers	6	600-hp. Diesel	American Loco. Co.
	2	600-hp. Diesel	Electro-Motive Corp.
Philadelphia, Bethlehem & New England	4	900-hp. Diesel	Electro-Motive Corp.
South Buffalo	6	600-hp. Diesel	American Loco. Co.
Steelton & Highspire	1	600-hp. Diesel	Electro-Motive Corp.
United Fruit Co.	1†	300-hp. Diesel-elec.	American Loco. Co.

Freight-Car Orders

Road	No. of cars	Type of car	Builder
Cambria & Indiana	500	50-ton hopper	Bethlehem Steel Co.
	300	50-ton hopper	Amer. Car & Foundry Co.
Peoria & Pekin Union	25	Hopper	Gen. Amer. Trans. Corp.
	25	50-ton gondola	Pressed Steel Car Co.
Soracabana	500	36-ton (metric) box	Pullman-Std. Car Mfg. Co.
Texas & Pacific	500‡	50-ton box	Pullman-Std. Car Mfg. Co.
	100	50-ton hopper	Bethlehem Steel Co.
Utah Copper	15	30-yd. dump	Austin-West. Rd. Mchy. Co.
	3	Caboose	Pacific Car & Fdry. Co.

Freight-Car Inquiries

Missouri-Illinois	50	50-ton box	....
	25	50-ton gondola	....
Union Pacific	50	50-ton box	....

Passenger-Car Orders

Road	No. of cars	Type of car	Builder
Pennsylvania	1	Diner	Edw. G. Budd Mfg. Co.

* Delivery now being made.
† For service in Panama.
‡ Ordered with an option for 500 additional.

Supply Trade Notes

THOMAS W. DELANTY has resigned as vice-president of the Ajax Hand Brake Company, Chicago.

THE INLAND STEEL COMPANY has moved its St. Paul, Minn., office to new quarters in the First National Bank building.

WAYNE Z. FRIEND has joined the development and research staff of the International Nickel Company, Inc., New York.

THE CHICAGO PNEUMATIC TOOL COMPANY has moved its Buffalo sales and service branch to 128 West Chippewa street, Buffalo, N. Y.

THE CHICAGO PNEUMATIC TOOL COMPANY has moved its sales and service branch at Buffalo, N. Y., to 128 W. Chippewa street.

THE M. D. LARKIN COMPANY, Dayton, Ohio, has been appointed distributor, in the Dayton area, for the General Refractories Company, Philadelphia, Pa.

R. M. NELSON, assistant manager of the Newark works of the American Steel Foundries, has resigned to become chief engineer of the Peerless Equipment Company, Chicago.

THE JOHNS-MANVILLE PRODUCTS CORPORATION, a subsidiary of the Johns-Manville Corporation, New York, has elected three new vice-presidents, as follows: A. R. Fisher, formerly manager of the company's factory at Manville, N. J.; J. P. Kottcamp, manager of the key Mid-Western factory at Waukegan, Ill.; and Alexander Cromwell, manager of the Pacific coast manufacturing operations.

CLARENCE D. HICKS, who has been elected vice-president of the Union Railway Equipment Company, Chicago, with headquarters at St. Louis, Mo., entered

Clarence D. Hicks

railway service as a special agent for the St. Louis Southwestern, from which position he later resigned to enter the employ of the supply department of the Missouri Pacific. Subsequently, he was employed in the mechanical, operating, engineering, traffic and executive departments. During the War, he served with the Federal Railroad Administration at Washington, following which he joined the staff of the federal regional director of the Southwestern region at St. Louis, remaining in that position until the end of federal control. He was then appointed assistant to the president of the Missouri Pacific. In 1928 he became special representative of the president on special duties in Old Mexico with headquarters at Mexico City, D. F. After completing this assignment in 1933, he returned to the United States and engaged in the railway supply business at St. Louis, Mo.

MARVIN MARSH, special Armco sales representative of the American Rolling Mill Company, Middletown, Ohio, with headquarters at Kansas City, Mo., has been promoted to manager of the newly created district office in that city.

OWEN C. JONES has been appointed assistant to the president and in charge of sales promotion for the Laminated Shim Company, Inc., Long Island City, N. Y. Mr. Jones has, for the past six years, been associated with the general publicity department of The Linde Air Products, a unit of Union Carbide & Carbon Corporation.

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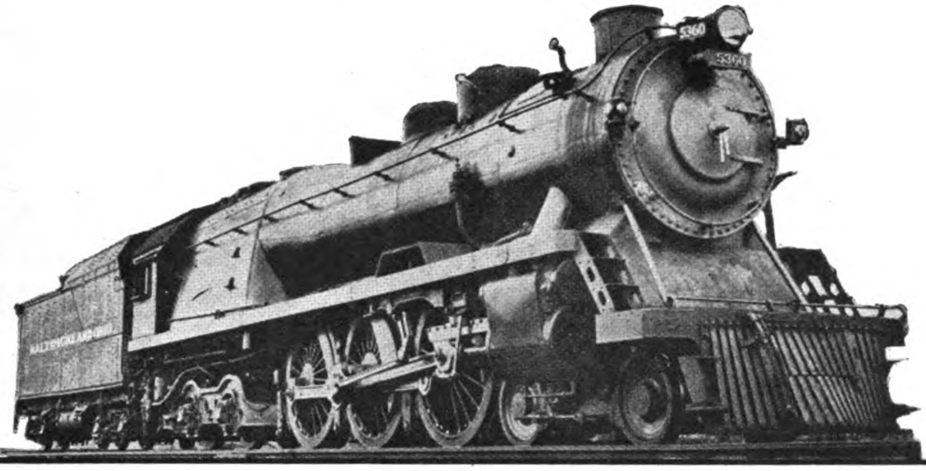


The Trend of

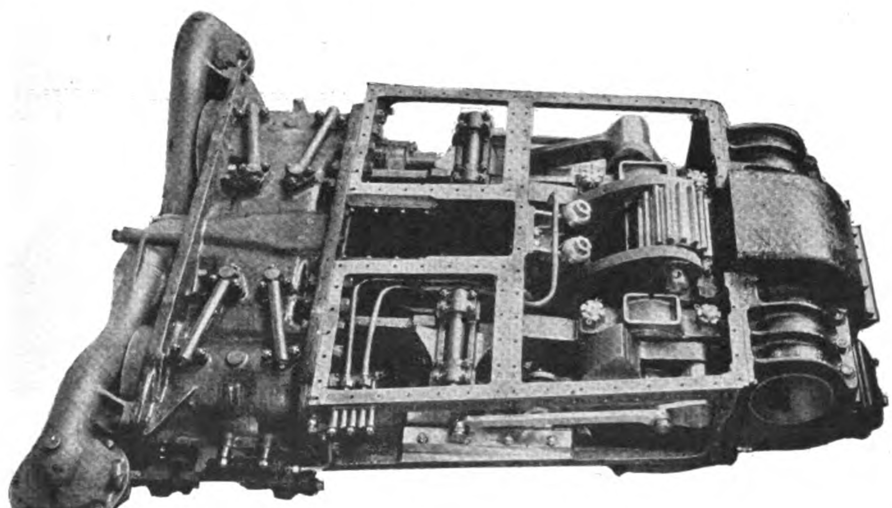
MODERN RAILROADING

Modern train operation requires locomotives having high capacity at speed, high starting capacity, and, for track safety, minimum weight on driving axles with low dynamic augment.

A reduction in driving wheel weights inevitably results in lower starting power. Higher train speeds necessarily require high power at operating speeds.

By incorporating the Booster in the original design to provide the needed starting power, capacity at high speed can be obtained with minimum driving axle load.

Such locomotives meet all the requirements of modern train operation.



Franklin parts fit—in applying them there is no labor cost for fitting. They are built to original dimensions of carefully selected materials—they avoid road failures and excessive maintenance.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

W. H. Scherer has been appointed manager of the Worthington Pump & Machinery Corporation's plant at Holyoke, Mass. Mr. Scherer previously served for 30 years with the Westinghouse Electric & Manufacturing Company.

R. B. Pogue, assistant chief engineer of the American Brake Shoe & Foundry Company, New York, has been appointed chief engineer; Rosser L. Wilson has been appointed assistant chief engineer, and Wallace B. Sutherland has been appointed assistant to the chief engineer.

J. Ryan, formerly with the Texas Company, and W. Rosser, formerly with the Symington Corporation and later with the Bradford Corporation, have been appointed special sales representatives of Iron & Steel Products, Inc., 657 Railway Exchange, Chicago.

The United States Steel Corporation confirms the sale to the Dominion Steel & Coal Company of its following subsidiaries located in Canada; namely, Canadian Bridge Company, Ltd., Canadian Steel Corporation, Ltd., Canadian Steel Lands, Ltd., and The Essex Terminal Railway Co.

W. A. Neill has been appointed manager of engineering and sales activities at the Holyoke, Mass., plant of the Worthington Pump & Machinery Corporation, Harrison, N. J. Mr. Neill was formerly manager of the corporation's Air Tool and Portable Compressor division, at Harrison.

E. K. Lofton, formerly railway sales engineer of the Dayton Rubber Manufacturing Company, Chicago office, has been appointed district sales manager, railway division, with the same headquarters. George S. Anderson has been appointed service inspector to replace field testing and development duties formerly handled by Mr. Lofton.

W. P. White has been appointed district manager in charge of steel and tube sales for the Steel and Tube Division of The Timken Roller Bearing Company in the Eastern and Southern Pennsylvania district, with headquarters at 1208 N. Broad street, Philadelphia, Pa. C. H. Kuthe will assist Mr. White. A. R. Adelberg, district manager in charge of Timken Steel and Tube Division sales in New York, with headquarters at 165 Broadway, will supervise steel and tube sales in the Philadelphia district as well as in the New York area.

S. L. Poorman, representative of the Westinghouse Air Brake Company in the eastern district, has been appointed assistant eastern manager, with headquarters as formerly at New York City. Mr. Poorman's education was received in the public schools of his home town in eastern Pennsylvania, at Mercersburg Academy, and at the Carnegie Institute of Technology. He entered the employ of the Westinghouse Air Brake Company in 1912 as an apprentice in the test division of the engineering department. Early in 1916 he was assigned to the Atlanta, Ga., office as mechanical expert, and five years later became representative. In 1926 he was assigned to the Washington, D. C., office in the same capacity. Three years later he went to Boston, Mass., as representative and in October, 1930, was transferred to the New York office as representative.

Joseph T. Ryerson & Son, Inc., Chicago, have just announced a system known as the "Ryerson Certified Steel Plan," which undertakes to select and grade steel by heat to meet narrow specification ranges, to make thorough tests and give the user a report on the analysis, tests, etc. The Ryerson company has been working on the plan for several years, adjusting stocks and ironing out operating problems. The plan, which is of particular value in connection with alloy steels that usually require heat treatment before use, may be summarized as follows: There is available from warehouse stock, alloy steel which has been selected to meet specifications much closer than the standard S.A.E. ranges and is accurately controlled in regard to grain size and other hardening characteristics. All bars except very small diameters are identified by letter symbols stamped on the ends of the bars for purposes of positive identification. Small bars are tagged. All bars have been metallurgically tested and the results of these tests which cover both chemical analysis and heat treatment response are tabulated and transferred to similarly identified data sheets. When a shipment is made to a user, a data sheet for the bars shipped is put in hands in sufficient time so that it can be transferred to the heat treating department before that department is called upon to subject the steel to heat treatment. The plan is designed to simplify the heat treating department's problem because they know exactly what material they have to work with, and also have been informed ahead of time as to how it will respond to heat treatment. It is expected that it will save time and money for users of alloy steel and assure far more uniform results than were previously attained. A booklet describing the plan and its advantages in detail is now being prepared and copies will be sent to steel users including railroads on request.

Obituary

E. V. Shackleford, vice-president, at St. Paul, Minn., of the Ewald Iron Company, Inc., Louisville, Ky., died on August 12, at his home in White Bear, Minn.

Thomas Hall Jessop, for a number of years eastern injector representative of William Sellers & Company, Incorporated, Philadelphia, Pa., died on August 31 at Harrisburg, Pa.

Max Breitung, president and founder of the Alfol Insulation Company, New York, died suddenly on August 19, of a heart attack, while playing tennis at the Gramatan Hotel Courts, Bronxville, N. Y.

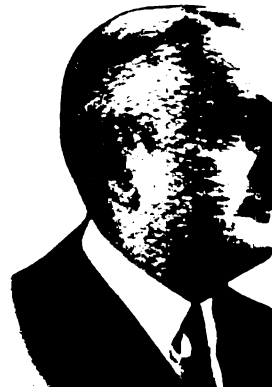
G. H. Dietz, of the Gould Coupler Corporation, with headquarters at New York, died on July 29, after several weeks illness, at his home in Mt. Vernon, N. Y., in his 48th year. Mr. Dietz left the operating department of the New York Central in 1911 to enter the employ of the Gould Coupler Company and was in its sales department at the time of his death.

Samuel D. Rosenfelt, who retired on January 1, 1937, as representative for the Franklin Railway Supply Company at St. Louis, Mo., died on August 29.

Oliver W. Loomis, former vice-president of the National Malleable and Steel Castings Company, Cleveland, Ohio, and a director for the past 13 years, died while on vacation August 19, at Ludington, Mich., at the age of 65 years. Mr. Loomis joined the National Malleable in 1891, serving in various capacities until 1919, when he was appointed sales manager. He was first vice-president from 1933 until his retirement in 1936.

Frank A. Barbey, who has marketed railway supplies in New England since 1887, died on August 10 at his home in Cambridge, Mass., at the age of 77. After spending the early years of his business life in ship chandlery and foreign trade, with several periods on the west coast of Africa and in South America, he established his own business in Boston in 1887. Mr. Barbey was associated with the development and introduction of many railroad devices. He had been an interested member of various supply associations and railroad clubs, and was a member of the finance committee of the New England Railroad Club at the time of his death.

Frank H. Clark, vice-president and a director of the Pilliod Company, in charge of the Chicago office, died suddenly at the Commodore Hotel, New York City, on August 18. Mr. Clark was born at Ballston Spa, N. Y., in 1871, and had been associated with the railway supply business for about 43 years, having entered this field in 1894 with the Standard Coupler Company. In 1912 he organized the Chambers Valve Company, which was acquired by the Bradford Corporation in 1923, and in 1916 the Elvin Mechanical Stoker Company. Mr. Clark later became associated with the Pilliod Company, and since October, 1929, served as vice-president in charge of the Chicago office and a director.



Frank H. Clark

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Personal Mention

General

W. R. HEDEMAN, assistant mechanical engineer of the Baltimore & Ohio, has been appointed assistant to chief motive power and equipment, with headquarters at Baltimore, Md.

A. C. ADAMS, superintendent of motive power of the Norfolk Southern, has retired, and the position of superintendent of motive power has been abolished.

R. C. GOEBEL, assistant to the general master mechanic of the Minneapolis & St. Louis at Minneapolis, Minn., has been appointed assistant to the superintendent of motive power. The position of general master mechanic has been abolished.

JAMES H. WILSON, chief mechanical inspector and assistant superintendent of motive power of the Norfolk Southern, has been appointed assistant chief mechanical officer. The positions of chief mechanical inspector and assistant superintendent of motive power have been abolished.

WILLIAM L. TROUT, general master mechanic of the Minneapolis & St. Louis, has been promoted to superintendent of motive power, with jurisdiction over the car department and headquarters at Minneapolis, Minn. Mr. Trout was born at Altoona, Pa. After a public school education in that city he entered railway service with the Pennsylvania on January 3, 1895, serving as an apprentice, machinist and enginehouse foreman at various points

William L. Trout

until October 31, 1913. At that time he left the Pennsylvania to go with the Western Maryland as general foreman in the mechanical department at Cumberland, Md., holding this position until February 28, 1915. On that date he severed his connections with the Western Maryland to go with the Baltimore & Ohio, where he served as general foreman in the locomotive department and acting master mechanic at Philadelphia, Pa. On January 1, 1916, he entered the service of the Long Island (part of the Pennsylvania) as general foreman in the car department at Jamaica, N. Y. From September 1, 1918, to June 30, 1924, he served with the Galena Signal Oil Company as a mechanical expert at Chicago. At the end of this period he entered the service of the Uintah Railway as superintendent of motive power at Atchee, Colo. On June 30, 1925, he resigned to become a special representative in the railway department of the Hulson Grate Company. From September 1, 1926, to December 31, 1932, he was a sales representative for the Gustin-Bacon Manufacturing Co. On February 1, 1935, he entered the service of the Minneapolis & St. Louis as a motive power inspector, being promoted to general master mechanic on March 1, 1935, which position has now been abolished.

Master Mechanics and Road Foremen

JOHN S. MASTIN, road foreman of engines of the Pocahontas division of the Norfolk & Western, has retired.

CHARLES NESBITT has been appointed master mechanic of the Nevada Northern with headquarters at East Ely, Nev., succeeding E. E. Jarrett, who has retired.

H. C. WYATT, general foreman of the Norfolk & Western at Columbus, Ohio, has been appointed assistant master mechanic of the Radford and Shenandoah divisions, succeeding F. D. Veazey.

F. D. VEAZEY, assistant master mechanic of the Radford and Shenandoah divisions of the Norfolk & Western, has been appointed master mechanic of these divisions succeeding R. J. Black.

J. W. MCAULEY, locomotive foreman of the Canadian National at Prince Rupert, B. C., has been promoted to the position of divisional master mechanic, with headquarters at Prince George, B. C., succeeding A. Watt, retired.

J. E. FRIEND, division general foreman of the Texas & Pacific, with headquarters at Shreveport, La., has been appointed master mechanic of the Rio Grande division, with headquarters at Big Spring, Tex., to succeed J. N. Blue, deceased.

L. T. FIFE, assistant master mechanic of the Southern Pacific, with headquarters at Sparks, Nev., has been appointed master mechanic of the San Joaquin division, with headquarters at Bakersfield, Cal., to succeed J. J. Keller, retired.

F. R. DENNEY, assistant master mechanic of the Texas & Pacific at Big Spring, Tex., has been appointed master mechanic of the Louisiana division, with headquarters at Shreveport, La., the office of division general foreman having been abolished.

PAUL J. DANNEBERG, who has been appointed master mechanic of the Panhandle and Santa Fe at Slaton, Tex., was born on October 12, 1894, at Kansas City, Kan. He attended grammar and high school and took courses in mechanical drawing, mathematics and English at night school in Kansas City. He entered railway service on May 20, 1909, as a wheel checker on the Atchison, Topeka & Santa Fe. Being under 16, however, he was laid off. On November 8, 1910, he re-entered the employ of the Santa Fe as a machinist apprentice, completing the course on November 29, 1914. He served as a machinist until September 1, 1915, when he became

P. J. Danneberg

assistant enginehouse foreman. On April 18, 1917, he became machinist gang foreman and on May 21, 1918, resigned. Passing examination as a first-class machinist, he was sent to Puget Sound Navy Yard at Bremerton, Wash. Upon his discharge in December, 1918, he became a machinist at the Argentine, Kan., shops of the Santa Fe. On January 18, 1919, he became machinist gang foreman; on September 13, 1920, night enginehouse foreman; on May 25, 1921, day enginehouse foreman; on February 24, 1922, general locomotive foreman. On July 5 of this year he was appointed master mechanic of the Slaton division of the Panhandle and Santa Fe.

Car Department

MILLARD E. JONES, car foreman of the Norfolk & Western at Lambert Point, Va., has retired.

A. M. MCLENNAN, coach foreman of the Canadian National at Saskatoon, Sask., has been transferred to the position of acting car foreman at Watrous, Sask.

R. LAING, car foreman of the Canadian National at Watrous, Sask., has been transferred to the position of car foreman at Biggar, Sask.

BYRON TAYLOR, coach carpenter at the Moncton (N. B.) shops of the Canadian National, has been appointed apprentice instructor, car department.

J. GLAZEBROOK, car foreman of the Canadian National at Biggar, Sask., has been transferred to the position of car foreman at Melville, Sask.

(Turn to next left-hand page)

W. S. Stillwell, car foreman of the Canadian National at Melville, Sask., has been appointed coach foreman, with headquarters at Saskatoon, Sask.

A. P. Gilsdorf, assistant car foreman of the Norfolk & Western at Shaffers Crossing, Va., has been promoted to the position of car foreman at Lambert Point, Va., succeeding M. E. Jones, retired.

J. D. Thress, inspector on new equipment, motive power department, of the Norfolk & Western at Lambert Point, Va., has been promoted to the position of assistant car foreman at Shaffers Crossing, Va.

Shop and Enginehouse

Henry F. Greenwood, superintendent of shops of the Norfolk & Western at Roanoke, Va., has retired.

J. W. Snyder, machine shop foreman of the Norfolk & Western at Bluefield, W. Va., has retired.

W. E. Pierce, erecting shop foreman of the Norfolk & Western at Portsmouth, Ohio, has been appointed back shop foreman, succeeding J. H. Hahn.

A. L. Wooten, a machinist of the Norfolk & Western at Portsmouth, Ohio, has been promoted to the position of assistant machine shop foreman, succeeding G. S. DeArmond.

G. S. DeArmond, assistant machine shop foreman of the Norfolk & Western at Portsmouth, Ohio, has taken over the duties of gang foreman in the erecting shop formerly handled by E. G. Goeller.

L. E. Berry, night enginehouse foreman of the Norfolk & Western at Bluefield, W. Va., has been promoted to the position of day enginehouse foreman at Portsmouth, Va., succeeding E. W. Meredith.

A. N. Myers, gang leader in the machine shop of the Norfolk & Western at Bluefield, W. Va., has been promoted to the position of foreman of the machine shop, succeeding J. W. Snyder, retired.

Sennett Holmes, night assistant enginehouse foreman of the Norfolk & Western at Bluefield, W. Va., has been promoted to the position of night enginehouse foreman, succeeding L. E. Berry.

L. E. McCorkle, shop inspector of the Norfolk & Western at Portsmouth, Ohio, has been promoted to the position of night assistant enginehouse foreman at Bluefield, W. Va., succeeding Sennett Holmes.

E. G. Goeller, gang foreman in the erecting shop of the Norfolk & Western at Portsmouth, Ohio, has been promoted to the position of erecting shop foreman, succeeding W. E. Pierce.

E. W. Meredith, day enginehouse foreman of the Norfolk & Western at Portsmouth, Va., has been promoted to the position of general foreman, with headquarters at Columbus, Ohio, succeeding H. C. Wyatt.

R. L. Black, master mechanic of the Radford and Shenandoah divisions of the Norfolk & Western, has been appointed superintendent of shops, with headquarters at Roanoke, Va., to succeed H. F. Greenwood, retired.

J. H. Hahn, back shop foreman of the Norfolk & Western at Portsmouth, Ohio, has been transferred to Roanoke, Va., as foreman of the machine shop, succeeding E. C. Gaines, deceased.

Purchasing and Stores

C. J. Kubler has been appointed general storekeeper of the Kansas City Southern with headquarters at Pittsburg, Kan.

U. K. Hall, general purchasing agent of the Union Pacific at Omaha, Neb., has been reappointed general storekeeper at Omaha.

B. B. Brain, purchasing agent of the Kansas City Southern at Kansas City, Mo., has retired from active service after 33 years with the company.

E. H. Hughes, who has been appointed purchasing agent of the Kansas City Southern, with headquarters at Kansas City, Mo., is 47 years old and has been connected with the company for more than 26 years. He first entered railroad service on July 6, 1906, with the Chicago, Burlington & Quincy, serving in various capacities with this company. In September, 1908, he went with the Missouri Pacific, serving as a laborer at St. Louis, Mo., until 1909, when he was appointed substorekeeper at the same point. In October, 1909, he was sent to Pueblo, Colo., as storekeeper. On February 1, 1911, Mr.

E. H. Hughes

Hughes entered the service of the Kansas City Southern as storekeeper at Pittsburg, Kan., continuing in this capacity until July, 1917, when he became chief clerk to the general storekeeper at the same point. On July 15, 1920, he was appointed general storekeeper at Pittsburg, which position he was holding at the time of his appointment as purchasing agent.

Obituary

William Alter, former general foreman of the passenger car department of the Central of New Jersey at Elizabethport, N. J., died on August 25 at the Alexian Brothers Hospital, after a brief illness. Mr. Alter, who was 73 years old, had retired on July 1, 1935, after 40 years of service with the Central of New Jersey.

John P. Young, formerly general inspector of passenger car equipment of the Missouri Pacific, who retired about 10 years ago, died of a paralytic stroke on August 28 at his home in University City, a suburb of St. Louis, Mo.

Edwin C. Washburn, assistant to president of the Baltimore & Ohio, with headquarters at New York, died on August 10 at his home in Englewood, N. J., of heart disease at the age of 67 years. Prior to his appointment as assistant to Daniel Willard, president of the B. & O., in 1911, Mr. Washburn had been general manager of the Washburn Steel Castings and Coupler Company, a company founded by his father. Mr. Washburn was the inventor of many railway mechanical appliances and was a participant in the early development of the automatic car-coupling device.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

Neoprene.—E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del., has issued a booklet describing Neoprene, an engineering material with rubber-like properties which, it is claimed, can resist the deteriorating effects of oil, heat, sunlight, chemicals and oxidation.

Alfol.—The Alfol Insulation Company, 155 East Forty-Fourth street, New York, has issued a loose-leaf booklet discussing Alfol, an aluminum foil insulation for refrigerator cars, passenger cars, locomotives, tank cars, caboose cars and other shipping containers.

Skid Platforms.—Many types of skid platforms for use in conveying materials, goods, parts and products by the lift truck method of interior transportation are illustrated in folder No. 146 issued by the Lewis-Shepard Co., 175 Walnut street, Watertown, Mass.

Shapers.—The attractive 34-page bulletin, No. 217, issued by Gould & Eberhart, Newark (Irvington), N. J., describes and illustrates G & E industrial shapers which are available in sizes ranging from 16 in. to 36 in. stroke. Universal shapers, equipped with swivelling tables and available in sizes from 14 in. to 36 in. stroke, are also illustrated.

Welding Symbols and Instructions for Their Use.—The symbols given in the 12-page booklet issued by the American Welding Society, 33 West Thirty-Ninth street, New York, are a development of the weld symbols in use here and abroad and supersede the former symbols of the society which were published in bulletin form in 1929 and revised in February, 1935. The symbols cover both fusion and resistance welding and provide the means of placing complete welding information on working drawings. A detailed explanation of the system and instructions for its use are available at 25 cents per copy.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal
With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, Railway Master Mechanic, and Boiler Maker and Plate Fabricator. Name Registered, U. S. Patent Office

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EDITORIALS

The Future of the Mechanical Associations

After years of suspension of activities and uncertainty as to their future, four associations of railway mechanical supervisors held conventions at the Hotel Sherman, Chicago, during the week ended October 2. All were successful judged by the character of the programs and the extent of the attendance. Their success was greatly enhanced by the extensive exhibit of locomotive, car and shop appliances to which approximately 1,000 railroad men gave close attention before and after the sessions of their conventions. The comments of exhibitors indicated unqualified satisfaction with the results from their standpoint. At the same time those registered at the various conventions were faithful in their attendance at all of the sessions. Concern was evident among members of some of these associations as to the attitude of the railway officers, or, more accurately, the attitude of the A.A.R., with respect to their future activities. There is no doubt but that this concern was justified by the unfavorable opinions expressed by a few railway executives. The work of these associations will no doubt always be opposed by some officers who are blind to the dormant powers hidden in the human material of which their organizations are built. These powers are seldom more than partially developed, unless released by inspiration and encouragement. Inspiration and encouragement grow out of mutual respect. What better evidence of mutual respect of the management for their supervisors can be shown than to encourage them to join with others of their kind, free from official domination or censorship, in the consideration of ways to improve the effectiveness of their work?

The cost of conventions such as those held at Chicago is a cheap price to pay for the results in education, in suggestions for new ways of exercising ingenuity, in inspiration which sends men back with renewed courage to surmount the never-ending obstacles with which their jobs are surrounded. It is true that the returns are not of the kind which can be computed in immediate terms of dollars and cents and turned in with the expense account at the end of the meeting. The account must be held in suspense until the next meeting and then it can only be appraised correctly by those officers who possess the insight to trace improvements in the functioning of their organizations and increases in the efficiency of their operations to ultimate causes. Those unfortunate officers whose thinking is limited to the mechanical processes of the adding machine, who are blind to those subtle qualities of human nature which distinguish men from machines, will never be able to evaluate such intangible values.

It may be admitted that there have been times when officers with the insight to appraise correctly the value of associations have had difficulty in finding a return which would justify the expenses entailed in sending some of their men to some of the meetings. The future of these associations is in the keeping of their officers and executive committees. The seriousness of purpose prevailing at this year's meetings was such that their future prospects are favorable. If they continue to improve on the more or less hastily developed programs which some of them had to depend upon this year, the question of their future will soon cease to be a matter of concern to their members or to the railway officers to whom their members report.

Car Department Association Makes a Good Start

The Car Department Officers' Association suffered the loss of as much morale as any of the associations, the activities of which were curtailed during the depression. Meetings were completely suspended and no effort was made to hold the members together after 1930 until this year. It was, perhaps, as much of a surprise to its officers as to anyone else that the registered attendance at the meeting during the last week in September was over 250. Such an attendance, no doubt, implies effective work on the part of the officers in preparing for the meetings. But it must also be taken as an indication of the vitality of the association idea among the large group of car department supervisors from which it draws its members.

The program of this meeting was not typical of the kind of work which this organization may be expected to do, now that it has reorganized and is ready for regular work. While the addresses and papers all held the close attention of attendants at the meeting and, together with the discussions of the loading rules and interchange rules, touched upon a fair cross-section of the interests of the members, there were no committee reports. These will, no doubt, be among the most valuable parts of future programs in serving the needs of the members.

The purpose of the organization, as it was well stated by President Nystrom in his address, is to create friendship and better understanding among member roads, to improve and simplify interchange in complete co-ordination with the Association of American Railroads, to

study for better and more economical maintenance of passenger-train and freight-train cars in daily operation, and to improve shop practices for repairing cars and building new equipment. These are all objectives which can be effectively advanced by a voluntary organization of men, whose leaders are so much interested in the welfare of the railroads that they are willing to give generously of their own time and thought in preparation for its meetings.

The evident anxiety of the members to make their association an instrument whereby they may co-operate with the A.A.R., presents that body with an asset which it can ill afford to neglect. On the other hand, it is to be hoped that wise councils will prevail in the latter organization, to the end that the Car Department Officers' Association may be left free to work out its own destiny, guided by occasional friendly advice, no doubt, but never forced into reluctant conformity with a program "handed down from the top shelf." Thus a highly practical contribution, of which the ranks of car department supervision are capable, will be made to the advancement of transportation efficiency.

Fuel Association Meeting

The Railway Fuel and Traveling Engineers' Association convention was notable for a number of reasons. In the first place, the total registration of 494 railroad members and guests brought to the convention the largest group of railway fuel supervisors and traveling engineers which has been assembled for the discussion of mutual problems since 1930. Railroad men from the Atlantic Coast to the Pacific and from Canada to Mexico were in attendance.

From the point of view of a well-rounded program, also, the convention this year probably surpassed any previously held. With five speakers of national reputation in the railway field, the members of the association listened to addresses which were at once inspiring and designed to give a broad picture of ways and means by which fuel supervisors and traveling engineers can help the railroads, these efforts covering the entire range from necessary public relations activities to fuel conservation efforts, closer supervision of locomotive operation and improved brake handling.

Eleven technical reports were presented and discussed in detail covering practically all important phases of work done by the members of this association. On the subject of Fuel Records and Statistics, for example, the intensely practical position was taken that no railroad can be operated efficiently without a certain amount of such records made promptly available, but that on the other hand, the compilation of statistics in excessive detail, at great cost, and issued too late for effective use, serves no good purpose.

The previous excellent practice of the association in presenting committee reports and addresses on the same general subjects in a single day was followed again this year. For example, the general opening session on Tuesday, September 28, was followed by Mechanical Day on Wednesday, September 29, on which reports were presented on New Locomotive Economy Devices, Steam Turbine Locomotives, Front Ends, Grates and Ash Pans, Valve Motion and Its Effect on Fuel Economy and Utilization of Locomotives. Similarly, Thursday, September 30, was Air Brake Day and Friday, October 1, Fuel Day, with appropriate addresses and committee reports presented on each. By this method, railroad men interested in a particular subject and with a limited time available away from their regular work, were enabled to attend the convention on the day or days when subjects would be presented in which they were most interested.

All of the sessions of the association were terminated early in the afternoon of each day so that the members would have ample time to visit and study the extensive and instructive exhibits of railway mechanical equipment and supplies presented under the auspices of the Allied Railway Supply Association. An unusually effective spirit of co-operation prevailed between the two groups of railroad and supply men. Railroad men who came to this convention, and to the other three as well, attended strictly to the business of increasing their knowledge of railway mechanical equipment, materials and operating methods designed for the roads' benefit.

The Exhibit At Chicago

Both the railway men and the exhibitors were enthusiastic over the exhibit which was staged under the direction of the Allied Railway Supply Association at the mechanical conventions in Chicago. Because of the late date at which it was decided to hold these joint meetings, the railway supply association was under a considerable handicap in arranging for the exhibit. In spite of this, however, all of the available space in the exhibit hall and on the mezzanine floor of the hotel was taken, and a most comprehensive and instructive exhibit was made.

The railway representatives were especially pleased with the fact that the exhibit room was darkened and that activities among the exhibits were discontinued while the railroad conventions were in session. The railway supply group, on the other hand, were very much delighted at the thorough way in which the railway men inquired about and studied the exhibits, which while occupying only about 14,000 square feet of floor space, were specially designed to be as instructive and educational as possible.

One gage of the success of the exhibit was indicated by the fact that several railway supply concerns which did not exhibit are already planning to do so next year. This may bring some embarrassment upon the officers in charge of the various associations, since it may in-

volve holding the convention at a place which can provide more commodious exhibit quarters. This, however, may be necessitated also by the fact that the associations will undoubtedly have a much larger attendance at the next meeting and it is also quite possible that more than four of the mechanical associations will meet at the same time.

A Glimpse of The Ultimate Goal

The 1937 meeting of the General Foremen's Association has passed into history and has left its mark. If there is any one thing that stands out in the minds of those who had a part in its preparation and who attended the meeting in Chicago it is the fact that united effort, faith in the value of the association and its work, and determined personal support resulted in bringing about a meeting far beyond the expectations of anyone. No one should be misled by the fact that the registration of 92 railroad members was only slightly more than 50 per cent of the similar classification in 1930.

The intervening seven years have brought about significant changes in railroading—both in the nature of work, in personnel and in the problems to be faced. The effects of these changes were clearly visible at the Chicago meeting. The papers and the discussions indicated that the technical details of the work of the mechanical department have changed materially with the development of new ideas in the field of transportation; a glance at the roster of those in attendance indicates that the intervening years have brought into the ranks of the supervisors within the scope of the association many new faces and, most important of all, there is today a recognition of the plain fact that the immediate future is going to impose upon the supervisor the responsibility of dealing with many problems which will require him to adopt an entirely new approach to his job.

Before the Chicago meeting there was a feeling on the part of many members of the association that it was on trial and that it would have to do an outstanding job in order to justify its future existence. The trial has been held and while the final verdict has not been rendered there should not be an individual who does not now know that the effort has been worth while and that the association, as a vital force in the mechanical department, has re-established itself and should now move on into a wider sphere of usefulness.

Under the former set-up this organization embraced the general supervisors in both the locomotive and the car departments. The Chicago meeting of this and the car department group should raise in the minds of those who are to govern the affairs of the General Foremen's Association the question of the desirability of building the future of the organization around the activities of the locomotive department—both back shop and enginehouse—and to broaden the scope of its work to include and be of interest to all supervisors of general rank who are charged with the responsibility of the maintenance of locomotives.

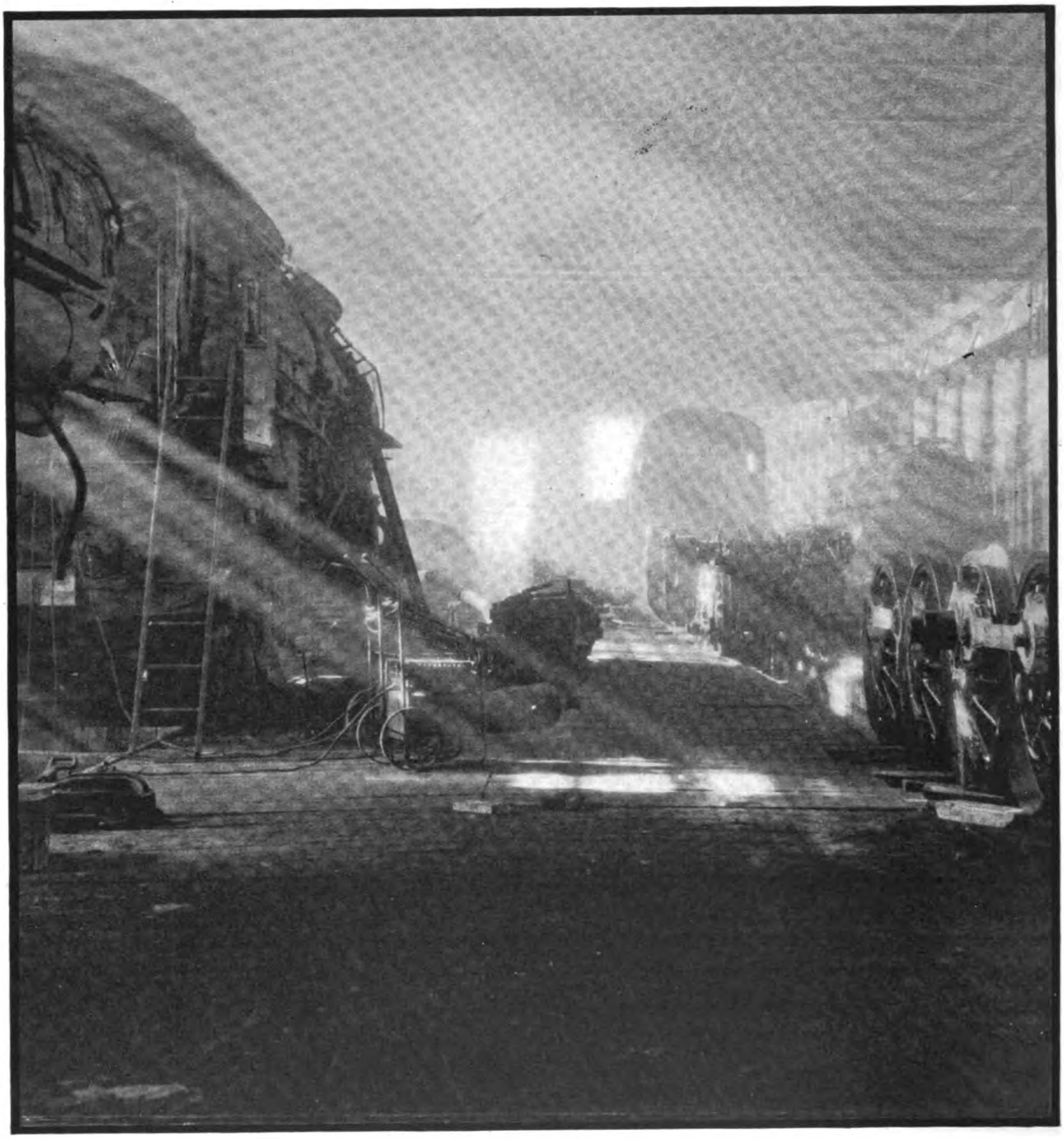
It is only necessary causually to explore this single field to discover that it holds untold opportunities for constructive and highly valuable work on the part of such an organization as this. It has been pointed out that the railroads of this country spend more money for the repair of steam locomotives than is spent on any other single operating account. While figures are not readily available as to the total investment in shop and enginehouse facilities directly allocated to locomotive repair work, when one considers that the shops of the Class I roads are equipped with 350 million dollars worth of shop machinery alone one begins to sense that this locomotive repair industry is of sizable proportions. This vast investment in facilities and the expenditures for wages and materials represent the field in which members of this organization move about in their daily work and in which their intelligent supervision is required to maintain proper control over the cost of keeping in condition the tools of transportation.

It would serve no good purpose to point out in detail the breadth of the opportunities for constructive organization work in the field of locomotive maintenance. Let it be sufficient to say that no time should be lost in planning a real program of future activities and in deciding what may be the most worth-while objectives toward which the work of the organization should be directed. The start has been made, but it's the finish that counts.

Boiler Maker's Meeting A Real Accomplishment

The increase in membership of almost 100 per cent in the last three years to a present total of 152 and the presence of a very large part of the membership at the meeting in Chicago on September 27 and 28 was an accomplishment in itself of which the association may well be proud but the real job that was done was the fact that all through the year, in preparation for the annual meeting, a comprehensive plan was worked out by the officers of the association that resulted in a program of outstanding scope and interest.

Unlike some groups in the railroad field the members of the Master Boiler Maker's association have been entirely alive to the rapid changes that are taking place which have a vital effect on that phase of equipment design and maintenance over which they have control. The scope of these changes and the serious consideration of their significance may readily be observed in the quality and breadth of the committee reports which were presented at the two-day meeting in Chicago; the fact that the members are exceedingly well posted on what is taking place in the field was evidenced by the nature of the discussion and the foresight of the officers in printing advance copies of the papers contributed.



Excellent Attendance and Exceptional Papers at the

General Foremen's Meeting

The importance of human relations in railroading brought out by principal speakers—Car repairs, safety work and machine tools covered at sessions

A TOTAL of over 90 members attended the two-day meeting of the International Railway General Foremen's Association, held at the Hotel Sherman, Chicago, on Tuesday and Wednesday, September 28 and 29. The opening session was called to order by F. T. James, Delaware, Lackawanna & Western, president of the association.

The importance of intelligent supervision, the training and selection of men and the opportunities for supervisors to be a factor in influencing favorable public opinion for the railroads were subjects relating to the broad problem of personnel at which the principal speakers directed their remarks. The first speaker on the program at the opening session was R. E. Woodruff, vice-president, Erie Railroad, who told the members in attendance that one of the most important jobs confronting the supervisor today was that of maintaining and improving morale among mechanical department employees. H. J. Schulthess, chief of personnel, D. & R. G. W., made a strong case for a revival of systematic training of employees for the future and pointed out the need for the establishment of standards in the selection of new men that would assure the railroads of men adequately fitted for the jobs which modern railroading requires. That the railroads can not succeed without the good will of the public was the theme of an address by Roy V. Wright, editor of *Railway Mechanical Engineer,* who pointed out the opportunities which the supervisor has to build such good will.

At later sessions individual papers were presented on freight car repairs by J. E. Echols, Norfolk & Western* and J. Thompson, Delaware, Lackawanna & Western. R. C. Helwig, Delaware & Hudson, discussed the subject of accident prevention and a paper on machine tools as a factor in reducing costs was read by L. H. Scheifele, Reading Company. The morning session of the second day was devoted to an open forum on questions submitted by the members.

Election of Officers

The following officers were elected to conduct the affairs of the association for the year 1937-1938: President, F. B. Downey, assistant supt. of shops, Chesapeake & Ohio, Huntington, W. Va.; first vice-president, J. W. Oxley, general foreman, C. & N. W., Maywood, Ill.; second vice-president, Charles Kirkhuff, general foreman, A. T. & S. F., Chicago; third vice-president, J. C. Miller, general foreman, N. Y. C. & St. L., Conneaut, Ohio; fourth vice-president, J. E. Goodwin, general foreman, Mo. P., Little Rock, Ark.; secretary-treasurer, F. T. James, general foreman, D. L. & W., Kingsland, N. J. The following members were elected to the executive committee: J. B. Dunlop, general foreman, Canadian National, Stratford, Ont.; F. J. Topping, general foreman, C. & O., Huntington, W. Va.; E. W. Brown, general foreman, St. L.-S. F., Kansas City, Mo.; W. L. Rice, supt. of shops, Reading Company, Reading, Pa., and H. H. Wheeldon, general foreman, Wabash, Moberly, Mo.

How Can Mechanical Supervisors Assist Management?

Supervisors today must be leaders of men and their most important job is to build morale

By Robert E. Woodruff

Vice-President, Erie Railroad

This is a broad question and can be answered in a number of ways. Your program indicates that other speakers will touch on some of the answers. Therefore, I will limit my remarks to one phase of the question, namely, improvement of morale among shopmen.

I am sure you all realize that good morale is the foundation of good workmanship, good production and good safety records. These three are the aim of every shop.

We approach this subject from different angles.

First, we try to provide adequate facilities; a good place for men to work—well lighted, comfortable and properly heated. Whenever possible new machines are purchased—machines that will do better work in quicker time with less physical exertion.

Then we talk safety and have safety supervisors, safety committees, safety posters and safety literature, all with the idea of influencing the workers to be safe.

But with all of these things, some shops do not produce as well as others and the question is merely one of morale and the way the men in the shop react to the supervision. Men work for many things besides their pay checks. They like to be well treated; like to feel

* The paper "Modern Methods in Freight Car Work," by J. E. Echols, N. & W., which was presented at this meeting, will be published separately in a later issue.

that their work is important; and like to have security in their jobs.

The attitude of the whole shop is in general the attitude of the boss, because attitude and morale are largely governed locally. A railroad is spread out so much that the men do not come in contact with the higher officers and accordingly get their viewpoints from their immediate superiors. No amount of intelligent planning on the part of the Superintendent of Motive Power will be effective in any shop unless his policies are adequately carried out by the supervision in that shop. Therefore, good morale is a local matter. Some shops have it; others do not.

Three Kinds of Men

To be more specific, let's look at it in a different way. All railroad employees might be divided into three groups.

The first group consists of individual thinkers who are very conservative, who realize the financial and economic condition of the railroads and of the country. They do their work well, save their money, educate their children, are not much concerned in what other people do and more than likely do not belong to any labor organization.

Another group is composed of radicals. They are not interested in the railroad industry as a whole but are out for all they can get individually. They are apt to be short-sighted, not recognizing the source of their bread and butter. They will vote for the union first, the good of the membership second and feel that anything that is desired by the railroad management should necessarily be opposed by the men.

The third group, which constitutes probably over half of the total number of employees, are conservative, like their jobs, are more or less satisfied with their working conditions and wages, but are willing to go along with the crowd when occasion requires and are influenced by one group or the other. They take no prominent part in civic or union affairs but at times are dominated by the radical group. The attitude of this middle group is very important to the railroad as a whole because these men are a majority and the backbone of the industry. Their attitude is quite dependent upon the way they are treated by their supervisors. Here then is a real field for constructive work on the part of mechanical supervisors.

This middle group is either going to look at things conservatively and intelligently for the good of all or they are going to be dominated by a more or less radical leader.

It is the obligation of the management to see that all questions which affect both the men and the company are fully explained; that the facts are presented so that men can understand both sides of the questions.

Some labor organizers frequently have distorted views of current questions which often are harmful to morale and are not counteracted by the truth.

Leaders as Well as Foremen

Railroad supervisors are expected to be leaders as well as just foremen. They have access to railroad literature, to various periodicals and books that are published in which railroad affairs and economic problems are discussed. The average workman seldom sees these. If the workers are to get such information they can get it only through their immediate superiors.

Railroads should let their employees know the facts about restrictive laws, such as train limits bills and so-called full crew laws, which are not in the interest of safety nor in the interest of the employees as a whole; they are purely make-work laws that benefit a small number of railroad employees and do harm to the rest.

You all know what happens when a railroad is forced to cut expenses and what men get the cuts. Men fight for security of jobs as well as for increased rates of pay. There can be no security of jobs when the railroads are continually harassed by ill-advised laws and restrictions and increased expenses.

Mechanical supervisors, if they are leaders, can see that the facts are properly presented to the men with whom they work, remembering that there are three sides to every question, namely, what we think; what the other side thinks; and the facts. The only way to get both sides to thinking and acting harmoniously is through the medium of the facts.

Thinking men who own their own homes do not want their taxes raised as they would be if the government takes over the railroads and the railroads no longer pay taxes. In many railroad towns and outlying townships, the portion of the total taxes paid by railroads is a very substantial part of the total.

Knowing all sides of the question will enable workers to use good judgment in their meetings. A labor organization should be essentially a democracy wherein the workers determine the policy of the organization, and it will be a democracy if the workers insist upon their rights and upon having a part in the management. If, on the other hand, the policies of the organization are determined by a small group, then the men have no voice and the leaders become czars instead of servants of the organization.

To bring this about, mechanical supervisors must be leaders—leaders in thought as well as in action. Their influence extends beyond the eight-hour day and it is dependent largely on how they conduct themselves during their tour of duty. If they are good managers and good executives and have the confidence of their men, their influence will be beneficial both to men and managements.

How can supervisors be better managers? Let's analyze the situation. As a rule, mechanical officers served their time at some railroad shop and became full fledged mechanics. It is considered essential that a man should know his trade before he can become a mechanical department foreman or officer.

As a mechanic, he learned many practical things. First, he learned something about materials. He did not necessarily learn the strength of materials as engineers and chemists know them, but by dealing with them he learned to know the different properties of cast iron, wrought iron, steel, brass, etc., and found out which was the best for certain uses.

Then he learned about machines; what work could best be done on a planer, slotter, lathe, grinder or milling machine. In connection with the use of tools and machines, he learned what depth of cut to take, what feed to use and what the speed of the machine should be, realizing that too heavy a cut or too high speed would burn or break the tool. He also learned that a heavier cut can be made with high speed tools than with the ordinary kind. He learned that fillets must be of the right radius and free from scratches, as fractures develop from sharp corners or scratches. All of this knowledge is thoroughly universal and definite in its application.

As a general rule, a machine can do the same work today that it did yesterday and last week; the same kind of iron or steel can be treated today as it was treated last week or last year; and that once a method is developed it can be used again under similar circumstances. One 8-inch lathe can do the work that another 8-inch lathe can do, and in general two similar machines will turn out similar results. Nearly everything is standard-

ized as to materials and workmanship. One locomotive will pull about the same train that another locomotive of the same class will pull.

Years ago broken parts that could not be welded in the blacksmith shop were thrown away. This was particularly true of castings. A broken cylinder meant a new cylinder. But in the last few years welding has developed to the extent that many parts formerly scrapped are reclaimed by welding. Even if the material is not broken, weak parts are built up and made as strong as before. Of course, the welder learns to use the right methods, including the right kind of welding wire, finding that some wire is better for some purposes than for others. The art of welding has progressed to the point that makes it possible to save many hours and dollars in repairing locomotives.

At some time or other a vacancy occurs in the foremen's ranks and one of these craftsmen is selected for the job. In place of doing the work himself, his new job is to supervise the work of the gang. He has previously learned about tools, machinery and materials, but the chances are that he knows comparatively little about being a foreman. Some men are natural foremen and have the ability to supervise the work of others; still others have to learn how. Many good workmen make poor foremen. The question is simply one of being a good manager.

How to Be a Good Manager

How does a man go about being a good manager? First, he must analyze the job, see what it is all about and how he is going to proceed. To illustrate: A foreman was criticized by his superior officer one day for not getting out enough work in the flue shop. This foreman was of the old school who used his lungs rather than his head. He went into the shop and got his men together, bawled them out and told them they had to get more work done and speed up to avoid criticism. Immediately the men speeded up. They worked harder and hurried, and some got their fingers pinched. Production did pick up somewhat at the expense of quality. Not long afterwards this foreman was replaced with another man. His attention was called to the flue shop and his reply was, "I'll look into it." He went down to the flue shop and studied it without comment. He found the shop poorly arranged. Flues that came in from the flue rattler had to be carried to the other side of the shop where they were cut off, then carried back to the welder. He re-arranged the layout and made it easier for flues to progress from one point to another; in fact, they all but rolled from one job to the next. The production immediately stepped up. The men did not work as hard as before but more work was turned out and there were no personal injuries.

The next step is to lay out the work and plan it so that it is in proper sequence. One of the difficult things in a railroad repair shop is to keep the shop balanced; that is due to the work running heavier on one engine than another. A good shop foreman will manage the work and lay it out so that one gang will not be kept waiting for materials or keep men in another department waiting for his men to get out of the way.

There should be a general knowledge of the whole operation on the engine and the work should be so planned that all gangs will work smoothly and no one unit will be holding back the rest. It is the supervisor's job to keep ahead of his work. If he does not plan ahead his job will run him instead of his running the job.

The next move is to see who is to do the work. Traditionally, the most inefficient workman in the world is the plumber who comes to do a job in your house. He comes to see what is required, does his measuring and then has to go back to the shop to get his tools and material, while you are paying the bill. Unfortunately, the same thing frequently applies to railroad work. The men find out what they are going to do and then go to the store room or tool house to get their tools. High priced mechanics do the work of laborers or helpers.

Some years ago one general foreman used to stand in his upstairs office and look down through a window into the shop and if the men were walking reasonably fast down the aisle to and from the tool room, he felt that the operation of the shop was good. He liked to see motion. As a matter of fact, his material delivery system was not functioning. Since that time he has learned that it is better to have the tools and material delivered to every job; and now he is happy when no men are moving down the aisle for tools and material.

Activity No Index of Efficiency

The efficiency of a shop is determined by planning rather than by hustle and bustle. Any supervisor should know that a man cannot run a mile at the speed of a hundred yard dash; that the way to get more work done is not to drive men but to make it easy for them to do a day's work smoothly and without fuss and feathers.

Mechanics do not like to do laborer's work. They are perfectly content to work their full time at their own trades and they are just as proud of their accomplishments at the end of the day as the foremen are. It is the foremen's job to see that this is possible.

The next point in proper supervision is the handling of men and this is probably the most important of all. A good supervisor must be a good manager. He learns very soon that men are not like iron and steel and machines and tools; that there are no two men exactly alike; that because one man turns out ten units in a day is no reason why another man will do it without proper training, even though the same machine is used. Each man must be trained differently. Many new foremen become impatient with men through lack of experience in handling men.

As a matter of fact, there are many things he learned while serving his time that should be useful to him as a foreman. For example: A cutting tool that loses its temper is worthless and so is a foreman who loses his temper. In order to temper steel some has to be heated white hot, some only cherry red; some pieces of metal can be straightened cold, others have to be heated. So it is with men.

It is part of a foreman's job to see that his men understand the reason for the operation. If a workman understands the principles behind the work, he will go on doing the job correctly day by day without instructions. A good foreman will permit a man to use his head in developing labor saving devices and improved methods.

Years ago many men were fired—thrown in the scrap pile just like broken castings. Now we weld the castings and it is a part of the foreman's job to use the same principle with his men. The old practice of hiring and firing is obsolete. It is now a case of taking what men we have and training them to do the job. In order to do this a foreman must be interested in the men and have their respect and confidence. He must be fair and square and play no favorites. It is a foreman's job to study the individual and figure out what method to use to accomplish the desired results. As a mechanic, he learned that rounded fillets must be left without a scratch to prevent a growing fracture. As a foreman, he must learn that when he corrects a man he must not leave him with a sense of injustice or injured feeling because this

will also develop into a growing and lasting fracture.

Boilermakers know that boilers must be inspected periodically, sometimes given a hydrostatic test. Men are really no different. A human being needs checking just the same as a locomotive boiler, following up with the necessary repairs.

The average man is fairly easy to handle and responds quickly to suggestions. A foreman must be big enough to encourage suggestions—not close the door to improvement. A foreman who "knows it all" is headed for the scrap pile. When a workman comes in with a grievance it should be carefully listened to. He should be given a chance to tell his whole story, realizing that he will feel better after having told it. If there is nothing to the complaint the man should be persuaded that such is the case. If, however, there is merit to his contention, it should be rectified. If it is not rectified, it will grow like the scratch in the fillet.

Those of you who are roundhouse foremen have often been called into a huddle to try to locate the reason for a locomotive not doing well or the reason for continued breakage of parts, and it is to be expected that after you have made a careful investigation you finally located the trouble and remedied it. Similarly, there are some men in almost every organization who are hard workers but who seem to get into trouble continually through doing their work the wrong way. They are stubborn and sometimes ordinary treatment does not straighten them out. These cases need special attention and if the supervisor can convince such a man that his trouble is likely to be caused by acting before he thinks, he can undoubtedly train him to think out what is going to be done first and then the job will be done right. The point is, we give careful consideration to the inherent defects of certain locomotives because of materials or design or workmanship and the matter is studied by experts. Do you give similar thought to straightening out either foremen or men?

Handling Men the Supervisor's Big Job

Handling the human element is the most important job of the mechanical supervisor. Colleges are turning out bright engineers who are keeping apace with the latest engineering practices and materials. Manufacturers are turning out improved machines and tools. But the handling of the human element is in the hands of the mechanical supervisors. In some shops on some railroads this has been sadly neglected. In this respect railroads are probably behind industry as a whole.

Once a year most railroads make a budget. Mechanical officers ask for new facilities, perhaps for new locomotives and cars, at least a few new machines, grinders, shapers, welders, etc. Possibly in late years most of them have been cut off of the list but undoubtedly a few improvements have been made. Do you ever attack the question of supervision and morale in the same way? Have you ever thought out what you need to make an improvement, then how to go about getting it and what would be its cost? It might be a worthwhile investigation.

In the first place, the boss of the shop must be the leader. He must train himself to be a good diagnostician and a good leader of men before he can act as a school-teacher for those who report to him. How can this be done?

There are many helpful sources of information. First, there is the experience of older supervision; foremen's training courses; correspondence school courses; in some cities there are night courses. There is a surprisingly good sample of what can be obtained in the set of six little pamphlets which the National Safety Council has recently issued, entitled "The Human Side of Safety in Foremanship." They are well written and give very practical illustrations of how to influence men along the right lines. The cost is nominal and I have yet to hear of an officer who has not become enthusiastic over them.

In conclusion, it cannot be emphasized too strongly that the proper handling of men and consequent improvement in morale has not been given adequate attention. It is a matter that is causing serious concern to railroad managements. The present unrest caused by rival unions more strongly emphasizes the hope that our men in shops can keep their heads, not be swayed by radical propaganda and at the same time use their influence and votes toward the end of protecting the industry which provides them with their livelihood.

No railroad can have a greater asset than good foremen and supervisors, with all that they mean to morale. And remember that mechanical supervisors are promoted *not* because of their ability as machinists and boilermakers, but primarily on their ability to lead and train men, and their greatest asset is to be known as good managers of men.

* * *

Locomotive shops, freight car shop, enginehouse and a powerhouse of the Northern Pacific, Brainerd, Minn.

How Long Can We Put Off Training Men?

Little has been done to establish standards of intelligence, ability and performance

By H. J. Schulthess

Chief of Personnel, Denver & Rio Grande Western

Let's not put this off any longer!

The greatest undeveloped resource we have left on our American Railroads today, is the human element. Generally speaking, this vast undeveloped resource is a veritable gold mine that has not as yet been tapped. What is the ultimate goal of any railroad as a whole? In my opinion, it is to handle the business it gets most expeditiously, most economically, and most safely. With our present facilities, the greatest single factor in the accomplishment of this ultimate goal is the human element.

When it comes to material things, the railroads have taken the lead among other industries in the setting up and establishment of material standards, and we have made real progress along these lines. When we buy some new motive power, rolling stock, rail, or almost anything, we are very particular about the specifications of every detail. We know the specifications and insist that they be met. We know considerable about the crystalline structure of various metals and their actions and reactions under varying conditions. We know considerable about welding various metals. We are constantly trying to better material things. If a casting or some part is found to be weak, we try to strengthen it. If some part on a locomotive or car fails, we make an exhaustive study in trying to determine *why* it failed, and we take steps to correct it, so that there will not be a recurrence of the same kind of failure. Apply these same principles to the human element, if you please, and then ask the question, "How much do we know about our employes, even those who have been in service for years?" Very little. "How much do we know about the human specifications of new employes who enter the service?" Practically nothing, except for the fact that they passed a physical examination.

No Specifications for Human Material

When it comes to the human element, it is sad but nevertheless true, that little or nothing has been done to set up and establish human standards, such as standards of intelligence, standards of knowledge, standards of ability and performance.

On how many railroads today, do we have proper entrance standards and certain human specifications for new employees? If we tried to find out as much about a new employee whose services we are purchasing, as we do about a machine tool or some other equipment that we are about to purchase, I am sure that our efficiency would be much higher than it is today. Good tools are of little use in the hands of poor mechanics. In the hands of good mechanics there is practically no limit to their usefulness.

Have we not failed to recognize the fact that, even though we had the best motive power, rolling stock, shops, enginehouses, roadbed, track, signal equipment, etc., that money can buy, our efficiency and the kind of service we render is governed solely by the human element?

The human element is the largest single item in any railroad budget. It represents approximately 46 cents of every dollar of operating revenues received by the Class I Railways in the United States. This item is seldom, if ever, discussed in a budget meeting. It would seem that the importance of the human element would also warrant appropriations for the maintenance of this item. We have maintained many locomotives and cars on our railroads that have been in service for years, and have striven constantly to modernize them by adding various new and improved appliances. What have we done to modernize the employees who have been with us for years? Is it not just as important to modernize them? You may say that this is the responsibility of each employee. But is it? I think it is the responsibility of management. Most employees are ambitious, and are willing to conform to any reasonable standards set by management, if management will take the initiative in encouraging them and at the same time make it possible for them to conform to the standards set.

Of all the departments that make up a railroad, I believe that the mechanical department is probably the outstanding example of the need for new and higher standards. We cannot hope to bring about new and higher standards, still better leadership, more intelligent supervision, and higher skill in the arts of craftsmanship, until we have a definite program for attaining these desirable ends.

Minor supervision, although intensely interested, can do little to bring about such a program except through the power of suggestion to the men at the top. The best program possible will not function efficiently or effectively unless the men at the top are sold on the idea and recognize the very important part that the human element plays in efficient, economical, and safe operation. The success of such a program requires the coordinated co-operation of every officer and supervisor.

In order to attain some of the desirable ends mentioned, there are certain fundamentals which must be considered and they should be considered in proper sequence. There should be certain entrance standards for each class of employee in the mechanical department. Each step in promotion may include additional standards.

Apprenticeship Essential for Training Continuity

It is only through apprenticeship, and proper apprentice training with assured continuity, that we will be able continually to set up new and higher standards of craftsmanship. This cannot be done with the older mechanics now in service. It must be done by the new blood injected into the organization. If we want future well trained supervisors, we must begin by properly training our apprentices today. In order to become a real leader a man must first learn to be a good follower.

Apprenticeship was practically abolished on our American railroads during the depression, and as a result we have a shortage of master craftsmen today. Some of the things we did four and five years ago vitally affect us today. The things we do today will vitally affect us four and five years hence, and even longer. It takes approximately four years for an apprentice to serve his apprenticeship. Thus, if we are to provide future mas-

ter craftsmen for 1942, and from then on, we must start the training of apprentices today.

The most logical and practical way of approaching the problem of training locomotive and car-department mechanics and supervisors is to start at the beginning and inaugurate an intensive and modernized system of apprentice training. To attain the desired results, such a system must be established on a firm foundation with an assured continuity. Due to the fact that the full benefits of such a training program are not attained for many years, it calls for intelligent, long-time planning.

The full quota of apprentices under the allowed ratio should be maintained. Many mechanical-department officers and supervisors have had a mistaken idea that there were at times, too many apprentices. They were wrong, and I will try to prove it to you. According to an accurate survey, which I made personally, and which covered several railroads and a period of many years, I found that only 36 apprentices out of every 100 indentured eventually completed their apprenticeships. Assuming that the allowed ratio of one apprentice to five mechanics was fully maintained—and it was not—on the roads on which this survey was made, this would graduate only enough apprentices to provide for an average yearly turnover among mechanics of 1.8 per cent. The normal average yearly turnover among mechanics is at least 4 per cent.

The erroneous impression about there being, at times, too many apprentices, was probably formed because many railroads did not absorb all of their graduate apprentices. This was due to the fact that they promoted helpers to mechanics and employed new men as mechanics whose only previous experience was as helpers on other railroads. This had a very bad effect on the morale of the good mechanics and a still more detrimental effect on the morale of apprentices.

Most railroads now have a ratio of one apprentice to every five mechanics, and if our shop craft organizations would thoroughly analyze this ratio, they would probably ask for a ratio of one apprentice to every four mechanics instead of one apprentice to every ten mechanics.

Applicants for apprenticeship should be carefully selected and should be given an entrance examination in order to determine their fitness and whether or not they have the mental capacity to assimilate technical training. In the past, many railroads have taken only those young men who have applied to them for an apprenticeship, instead of going out after the most desirable applicants.

Many young men who are naturally gifted along mechanical lines and who on their own initiative are attending trade and vocational schools; who already know how to read blueprints and make an intelligent freehand sketch; who can tell the difference between a lathe and a boring mill; and who are not fooled if someone tries to send them after a left-handed monkey wrench, would be glad for the privilege of serving an apprenticeship if given the opportunity. Believe it or not, some of these fine young men do not even know about the opportunity of apprenticeship on our railroads. No one has told them about it. If the supervisor of apprentices will visit some of these trade and vocational schools and talk to the senior class about the opportunities of apprenticeship, he will have more applicants than he can use.

Master Craftsmen the Objective of Apprenticeship

A modernized system of apprentice training should give an apprentice every opportunity to learn all branches of his trade in order that he may become a master craftsman. Shop schedules for apprentices—the moving of an apprentice from one operation to another—should be worked out for each craft, in line with the facilities at each shop point where apprentices are employed. If we want to make master craftsmen, we must also give apprentices a thorough and intensive technical training, because there are many things which they cannot learn by practical experience alone, and they will be only about half as efficient if we do not include a technical training as a part of their apprenticeship. The technical training for apprentices should include a thorough training in the fundamentals common to all mechanical-department shop-craft work. After completing these fundamentals, the training should be highly specialized for apprentices in each craft on the technique of their craft work. There should be no discrimination between crafts. By that, I mean that if there is only one upholsterer apprentice on the railroad, he should be assured the same thorough training pertaining to his craft as a machinist or a car-builder apprentice, in which crafts most of the apprentices are employed.

The training program should include every apprentice on the railroad, no matter where located, and should be designed so that there is as little interference as possible with shop routine. It should be supervised by a competent, qualified supervisor of apprentices who should be on the staff of, and report directly to, the chief mechanical officer of the railroad. Definite records should be kept on the progress of each apprentice, both in his shop work and in his technical training. In the latter, he should be required to qualify on a monthly progressive study schedule. Each apprentice should be rated monthly on his shop work and on certain personal characteristics by the foremen under whom he has worked. This rating sheet should be approved by the general foreman and the master mechanic or shop superintendent.

After standards of craftsmanship have been established through apprenticeship, then, and not until then, can we expect mechanics in the locomotive and car departments to conform to these standards. The mechanics then have definite incentives and will respond either on their own initiative, or by suggestion, to a post-graduate training program outlined by management, provided it is practical and is suited to the needs of each mechanic.

As I mentioned before, we know considerable about

"If we are to provide future master craftsmen, we must start training apprentices today"

the crystalline structure of various metals and their actions and reactions under varying conditions. How much training have we given our supervisors to enable them to know something about the actions and reactions of the men they supervise under varying conditions? I have mentioned that good tools are of little use in the hands of poor mechanics. And the same thing is true about good mechanics in the hands of poor supervisors.

Supervisors Need Special Training

The training of supervisors is the keystone in the entire training program. I do not mean that we do not have good supervisors, but I do mean that there is not a single supervisor who cannot become a still better supervisor.

Again, it is sad but true, that we still promote men to supervisory positions very much the same way we did 50 years ago. Generally speaking, when a man is first promoted to a supervisory position, he makes the transition over night from an employee to an employer without any specialized training in the multitudinous problems of supervision and with little, and sometimes no, definite fore-knowledge of his new duties and responsibilities, and particularly the desirable ends he is expected to accomplish in the position to which he has been promoted. There should be a definite program for the selection and training of understudies for supervisory positions, which should also include men now in supervisory positions who are considered good material for promotion to higher supervisory positions. There should be at least two understudies for each supervisory position in order that the selection in filling a vacancy may be made on a competitive basis..

If management on our American railroads will analyze the problems mentioned, it is bound to arrive at the conclusion that the further development of the human element is not only highly desirable but absolutely necessary if we are to keep pace with progress and keep adaptable to meeting constantly changing conditions.

How long can we put off training men—locomotive- and car-department mechanics—supervisors? Only until the men at the top recognize the wisdom and necessity for doing these things and give their whole-hearted support and co-operation to such a program.

The D. & R. G. W. Apprentice Club

And now I would like to tell you something about what the Denver and Rio Grande Western is doing along these lines. I am sure you have all heard of the "Scenic Line of the World." I am proud to say that the trustees of this railroad, Wilson McCarthy and Henry Swan, as well as other officers, recognize fully the importance of the human element and are giving their wholehearted support and co-operation to the program we have started.

The apprentice-training program mentioned is in operation on this railroad and is functioning smoothly and efficiently. We have an outstanding apprentice club at each shop point where apprentices are employed. The apprentices elect their own officers and the meetings are conducted by them. One of the things that these apprentice clubs accomplish is the broadening of an apprentice's knowledge of railroading in general. The principal speakers at these apprentice-club meetings are officers and supervisors from the different departments, and sometimes representatives of railway supply companies. The superintendent tells the apprentices something about his problems and the work over which he has supervision. After he has finished, the meeting is thrown open for discussion, and the apprentices are not a bit bashful about asking questions. Other division officers, such as the master mechanic, division engineer, trainmaster, chief dispatcher, division storekeeper, road foreman of equipment, various shop foremen, etc., do the same thing. At some meetings demonstrations are given and sometimes motion pictures and slides are shown. These meetings have proved so interesting and educational that many of the supervisors and mechanics also attend.

At the last apprentice-club meeting in Denver the meeting was attended by the trustees, the vice president and general manager, the chief mechanical officer, the general auditor, the purchasing agent and general storekeeper, the superintendent of transportation, the superintendent of telegraph, the engineer of tests, the mechanical engineer, the supervisor of safety and fire prevention, the commerce counsel, the valuation engineer, the state supervisor of trade and industrial education, the principal of the vocational training school, the coordinator of the Denver public schools, the division superintendent, the master mechanic, the trainmaster, and many other officers and supervisors too numerous to mention, in addition to over one hundred apprentices. Have you ever heard of anything like this before in the history of railroading?

All of the things mentioned can be done and I believe will be done. While we have made a start, we realize that we still have a long way to go, and I hope that in the continuation of our work along these lines we will always be mindful of the fact that:

"To know what to do is WISDOM.
"To know how to do it is SKILL.
"To do it as it should be done is SERVICE."

Freight Car Repairs on the Lackawanna

Brief description of the methods in a dead-end shop where men rather than cars are moved

By J. Thompson

General foreman, Delaware, Lackawanna & Western

I believe it would be interesting to explain the layout of the Delaware, Lackawanna & Western Keyser Valley car shops, located on the outskirts of Scranton, Penna., approximately 135 miles from New York and 262 miles from the western terminal, Buffalo, N. Y. The shops were located at this strategic point in the heart of the anthracite coal region as all coal carrying cars are handled in and out of this territory. The entire plant layout covers 83 acres and comprises seven main buildings, consisting of the machine and blacksmith shop, sawmill, two car repair shops, paint shop and annex. The buildings are 33 years old and improvements have been

added from time to time and they are still suitable for present requirements. In addition to the above there are two auxiliary buildings, one a modern oil and waste reclamation plant and the other a brake beam assembling and dis-assembling machine, tension rod bending machine and a testing machine.

The storage space provided has a capacity of 500 cars.

Recently 450 wood side gondola cars were converted to steel-sided gondolas, making them all steel with the exception of wood floors and stringers. Following is a description of the work. Dead-end shop tracks necessitate the progressive movement of the men rather than of the cars. The first operation is to remove the side planks, floor sills and side stakes.

Next the cars are sent to the steel track where all deteriorated parts are removed and renewed, the couplers and draft gears removed, inspected and renewed where necessary. All other parts are then inspected and renewals made as required, complete reworking of the trucks is done at this time, the air brakes are given a general overhauling and pipe work completed. All rust and scale is removed from the underframe after which it is given one coat of red lead.

The next operation is that the bulb angles, side sheets, and stakes are placed in the jig, fitted and riveted ready for application to the side sills of the cars.

The sides are then lifted by an overhead crane and placed against the sills, then fitted and riveted to the present steel side sills, end gate and locks are applied in this position.

As the cars pass out of the shops, the underframe and sides are sprayed with one coat, which saves a day at the paint shop. The cars are then placed in another shop for application of wood stringers and floors, after which they are placed in the paint shop for a second coat of paint, the cars are then weighed and stencilled and are then ready for service.

Rebuilding of 450 Box Cars into Steel Auto Cars

The operations in rebuilding an 80,000-lb. capacity wood-sheathed box car into an all steel automobile car are also interesting and will be described briefly.

The first operation was to remove the roof, wood side sheathing, lining, floors, wood posts, and braces, etc.

The next move was to place the cars on the steel track where all parts were inspected and those found defective were removed and replaced with new parts. The couplers and draft gears were removed, inspected, and renewed where found necessary.

This procedure was followed for all parts of the car. All rust and scale was removed from the underframe, after which all parts were given a coat of red lead. The air brakes were given a general overhauling as well as inspection and completion of the pipe work and complete re-working of the trucks in this position.

The assembled steel sides were then hung on the car, using a locomotive crane. One of the interesting features was that the steel sides were removed from the car in which they had been shipped and placed directly on the car. The steel carlines, ridgepole and purlins were fitted and riveted in a jig located on the ground and when completed placed on the cars by a locomotive crane.

In the next operation the car was squared, fitted, reamed and riveted. The door tracks were also fitted and riveted in this position.

The floor stringers, floor, side posts, door and corner posts, roof, grain strips, end lining nailers and all lining was then applied. The application of the safety appliances was made while the car was in this position.

The cars are then sprayed with two coats of paint. The door posts and the inside of the steel doors are also given a coat of paint.

The cars are weighed and stencilled, after which they are ready for service.

Mechanical Supervisors and Public Opinion

Many things can be done to cultivate more friendly relations with the public

By Roy V. Wright

Editor, Railway Mechanical Engineer

Industry—and in a broad way it includes our transportation system—is on the spot today! In spite of the fact that private management in industry and on our railroads has been unusually successful in developing our national resources and giving our people by far the highest standards of living of any country in the world, much dissatisfaction prevails and politicians and theorists are attempting to take over the task of directing and managing them. Despite, also, the obvious gross inefficiency in government administration, some of the railroad labor leaders are openly espousing government ownership of the railroads; others are not going quite so far, but are pursuing tactics, which, if successful, will force more of the railroads into bankruptcy and may bring about government ownership, whether it is the desire and will of the general public, or not. Steady heads and courageous hearts are necessary on the part of our people, if we are to come through the storm safely.

Many of the railroads have well established departments, the objectives of which are to keep the public informed about railroad doings and cultivate a friendly spirit toward the railroads. As you very well know, the Association of American Railroads recently embarked upon an ambitious program in the attempt to demonstrate the advantages of the railroads to the public and to bring about more friendly relations. American industries are following suit, continuing their intense sales advertising programs, but also at the same time giving more and more attention to educating the public as to their importance in the economic life of the communities in which they are located and the vital part they play in American life as a whole. This new emphasis is necessary in the effort to bring about better and more intelligent understandings and to prevent unfair legislation and regulation, by bringing informed public opinion to the support of the industries and holding in check unscrupulous and short-sighted politicians and thoughtless demagogues.

The great problem in industry and on the railroads is to educate the employees as to the actual conditions and

some of the handicaps under which their employers are laboring, and to inspire and stimulate the employees and supervisors to get these facts over to the public. This has been accomplished remarkably well in a few places, but very little, if at all, in others. In the short time at my disposal this afternoon I shall attempt to point out a few ways in which the supervisors and foremen can render constructive and worthwhile service in this respect.

Too frequently the newspapers and the public have little or no appreciation of the number of employees and the size of the payroll of a railroad repair shop, or of a locomotive terminal, or of a car repair yard; nor do they understand the heavy taxes which the railroad must pay to local, state and federal governments.

When the money paid to the employees in a particular community is broken down into the amounts spent for different kinds of food, or clothing, or rent, or other important items—and the newspapers will usually be glad to print reliable facts about such matters—it awakens the tradesmen and professional men to the advisability of doing their part in conserving such an asset.

The industries of an eastern community recently banded together to collect and disseminate such information about their operations collectively; they found the press glad to receive such data and to comment upon it editorially. Railroad employees and taxpayers organizations in some localities have gotten excellent results in cultivating a more favorable opinion toward the railroads in just this way, but unfortunately, too few groups have taken part in such campaigns.

Plant Visitations

Probably you do not realize it and quite possibly, also, you may not wish to incur the trouble, but considerable numbers of the public will gladly avail themselves of invitations to visit your shop or enginehouse or other facilities, or to inspect a new or rebuilt piece of equipment, such as a car or a locomotive. This experiment has been tried out in a number of places in the past few years and with surprising and gratifying results. One railroad repair shop has a standing invitation out for groups, properly organized and conducted, to visit its plant. Many school classes or organizations, such as troops of Boy Scouts, have taken advantage of this invitation.

A boy or girl, telling at the supper table of his or her observations and experience in making such a trip, may have a strong influence in making the parents more sympathetic and more interested in the welfare of the railroad. Such visits are reflected, also, back in the classroom, by a desire for more information about the railroads; and any unbiased study of the conditions under which the railroads operate and of their contribution to the general welfare of the public, will surely redound to the interests of the railroads and their employees. There are incidental advantages, also, to such inspection trips by the younger people, or by older ones as well. The employees are inclined to spruce up and give greater attention to the appearance and cleanliness of their machines and surroundings, and as you well know neatness and cleanliness are usually associated with improved efficiency and production.

Exhibiting New Equipment

Railroad managements have been amazed at the interest which the public has taken in the new streamline trains when they have been placed on exhibition, or even in new or rebuilt cars and locomotives of the ordinary types. Here is a great potential asset, which has been lying practically dormant, for making people railroad-minded, and yet it can be realized upon with comparatively little expense. The difficulty, as I see it, is that we have construed our responsibilities too narrowly. We have concentrated on repairing and maintaining the equipment and have lost sight of the fact that in our own selfish interests we have a real selling job to do. If we do not all do our little part in cultivating a more intelligent and favorable public opinion toward the railroads, this vital and fundamental part of our national transportation system may function so poorly, because of lack of public support, that our jobs and those of great numbers of employees may be seriously jeopardized; indeed, I have so great faith in the important part that the railroads play in our national economy that I truly believe the public will be the principal loser, and this largely because we have failed in properly educating and cultivating it.

Support from Railroad Fans

I wonder how closely you have followed the development in many sections of our country of running special trains over week-ends to visit railroad facilities. Such trips have been largely inspired by outsiders; indeed, it was rather interesting to note the reluctance of some railroad managements in meeting the demand for such tours. It has been a revelation to find the great number of people, not boys and girls, but grown-ups, including men prominent in business and professional life, who seem to find as much satisfaction in making such trips as does the small boy in visiting the circus. Moreover, most of them have a surprising knowledge and understanding of the different types of equipment and facilities and their details. It may be a hobby with them, but they certainly do go to the bottom of things and many of them are simply "nuts" on the railroads. I have known some of them—not railroad employees, mind you—who will not buy materials that they know are not shipped by railroad. Surely such people are well worth cultivating, but are you doing so?

Railroad Model Makers

There is another class closely allied to these railroad fans, and that is the model makers. Recently in a city of about 150,000 inhabitants, I found a group of 57 of these model makers, with a well-equipped headquarters in a factory loft. Incidentally, they were much disturbed because of the delay, due to economic conditions, in the revision of the Locomotive Cyclopedia. Most of them were engaged in making models of railroad equipment. Apparently they have different grades of membership, just as do some of our engineering societies, depending upon their proficiency and the standards to which they have advanced in making models of railroad equipment.

A nuisance, you may say, if they bother you too much for information about the details of your equipment, but what an asset they may be in fighting with the legislators and demagogues for a square deal for the railroads. I have found some of them who could make a more effective and logical defense of the railroads than most railroad men—yes, than many railroad officers—and it is all the more effective because it comes from men not dependent on the railroads for a livelihood. Use your imagination and in dealing with such men recognize their potential possibilities as friends of the railroads.

Railroad Employees and Taxpayers Associations

There has arisen in recent years a movement which we must not overlook and which is deserving of our support. Numerous railroad employees have awakened to the fact that a politician who is supposed to be in

favor of organized labor, but who at the same time does everything he can to put the railroads out of business, is a mighty poor friend of the working man on the railroad. In short, railroad employees are beginning to understand that, if they want to keep their jobs, they cannot continue to vote for candidates simply because they are pro-labor, but they must also demand that they be pro-railroad as well. That is to say, a candidate to be a real friend of organized railroad labor, has got to be a man in favor of regulating competing agencies of transportation. He must be an opponent of excessive expenditures on highways and waterways. He must favor the Pettengill bill to abolish the long-and-short-haul clause of the Interstate Commerce Act. He must favor adequate fees for the use of public highways by commercial motor vehicles.

If a politician does not stand with the railroad working man on these questions, but still claims to be in favor of high wages and favorable working conditions on the railroads, then he is simply offering the railroad employee a fancy piece of frosting with no cake underneath. Because high wage rates and short hours on the railroad mean nothing unless there are some railroad men working under those conditions; and railroad men will not be working under these or any other conditions if the bulk of railroad traffic is unfairly diverted to the highways and waterways.

I say that the railroad employees are waking up to this situation and that as a result of their waking up the handicap to the railroad industry having no vote will soon be a thing of the past—provided, that is, that the employees are given a reasonable opportunity to organize politically for the defense of railroad traffic and railroad employment.

Five or more years ago there began to be organized in various parts of the country organizations of railroad employees known variously as "Railroad Employees and Taxpayers Associations," "Ship by Rail Clubs" and "Railway Employees and Citizens Leagues." These organizations met with varying success. Usually where the organizations received the sympathetic co-operation of railway managements, they were able to play a substantial part in getting on the statute books favorable legislation for the adequate regulation and taxation of railway competitors. Just to cite one example—Kentucky—railroad employees, both organized and unorganized, working in complete harmony with railway managements, were largely instrumental in getting on the statute books a law which prohibited trucks of over nine tons gross weight from the highways in that state. Similar legislation has been secured in other states by the same procedure.

Some managements have been unduly afraid of these employee organizations, fearing that they might be used for anti-railroad purposes, such as full crew laws and the like. Similarly, some of the labor executives have been suspicious of this activity for fear that it would be used against the labor organizations. However, as a matter of actual experience, in those states where the managements and employees have dealt frankly with each other, recognizing that they had some interests which were not mutual, both sides agreeing not to use this joint effort for any selfish partisan purpose, the plan has worked out without any cause for criticisms by either organized labor or management having arisen.

It is my belief that railroad managers and supervisors should give every aid which they consistently can to legitimate efforts on the part of employees to protect their jobs by political action in defense of the railroad industry. If the managements will play on the square with the employees and organized labor in a movement of this kind, I believe they will have no difficulty with these organizations developing in an anti-management direction.

Certainly the railroad industry is today a target for all kinds of unfavorable political action. An industry cannot defend itself or command the respect of politicians unless it has some votes to back it up. Where can the railroads hope to get the necessary votes if not among their own employees? The alternative of discouraging employees in this activity and allowing the situation to drift, is one of certain disaster for the railroads, because highway and waterway competitors have got votes and are using them against the railroads. If the railroads will not co-operate with their employees to have the employee vote used in behalf of the industry, then the outlook is black indeed.

Right here in Illinois there is one of the most active of these employee organizations. They also are operating in perhaps a dozen or more additional states. I can think of no better way in which the members of this association could exert themselves for the preservation of the railroad industry than to get acquainted with employees who are interested in activities of this kind, and co-operate with them in every legitimate way.

A Good Advertisement

In the statement which I am about to make I beg of you not to misunderstand me. It is not my purpose to criticize, but rather to attempt to make helpful and constructive suggestions. Anyone who was a close observer of railroad activities during the depression years could not but be impressed by the loyalty and the dogged persistence with which the supervisors and foremen in the mechanical department fought against heavy odds for the preservation of the railways. For this they are entitled to the greatest amount of credit.

With this appreciation as a background, let me state that one of the best assets in building good will toward an institution is a body of capable and satisfied employees. You may argue that wages and working conditions are largely beyond your control, since they are arrived at by collective bargaining processes, and that these are important factors in making for satisfied employees. You cannot sidestep the fact, however, that the supervisors in charge of the shops and the various departments are really the vital factor in building up the morale of the group under their direction. What about you, yourself? Are you a successful administrator? Are you constantly studying and striving better to understand your men and to educate and inspire them to more intelligent effort? What about your shortcomings and faults in dealing with other people? What are you doing to overcome these shortcomings and to improve your performance in contacting with your associates and your subordinates?

Walt Wyre is one of the very few writers in railroad technical publications, who has the ability to dramatize and present important facts about railroad operations and practices in story form. Walt Wyre made good as a journeyman after a strenuous apprentice training. Later on, when he wanted to take up literary work in his spare time, he faced certain facts fairly and squarely. It had taken him four years to complete his apprentice training in his trade and then he was only just well started. He decided that it would take at least that much time to train himself as a writer and start to capitalize on his product, and he went at it in that spirit. He had natural talent, but he has made good in becoming a master in his art by hard and careful study and critical attention to details.

Most foremen and supervisors worked hard to mas-

ter their trades as craftsmen, but have they given an equal amount of study and thought to the art of directing the human element—a far more complicated and difficult problem than that of dealing with materials?

The task of successfully directing the human element is a real art and profession, although this has not been recognized as widely as it should have been. The rules of the game, or the fundamental principles, are now thoroughly well understood. It is true that much depends upon the native ability of the supervisor, but much also depends upon understanding the art and of knowing how to practice it. There are plenty of opportunities, if one is on the alert to learn of these principles and how they should be applied. Good books, study courses, classes and discussion groups in foremanship and other means, are at hand. I have seen foremen who were only just getting by, speed up and make real records when they undertook studies of this sort.

Interest Yourself in Community Affairs

One fine thing about many of our railroad supervisors and employees is that they are unusually good citizens, and because the railroad is judged in the local community by its representatives, its reputation is thereby enhanced. Then, too, foremen and supervisors who come in contact with other people active in civic affairs, are in a position more or less informally to interpret the policies of the railroads and its needs to these people. We live in a democracy, and in the last analysis the people rule. A democracy in these days, however, must be representative and the responsibility of governing the community must be largely entrusted in the hands of a comparatively few key people. Railroad supervisors interesting themselves in and taking part in community affairs, not only make an impression upon the entire community, but will naturally contact more intimately with the leaders in civic affairs, who can be most helpful, if they have a proper understanding of railroad conditions.

I might go on in great detail, but I think I have said enough to indicate that there are almost numberless opportunities for railroad officers and supervisors to contact favorably with the public and to assist in bringing about better understandings and more friendly relations between the railroads and the public.

Can Modern Machine Tools Cut Repair Costs?

Costs could be cut with the aid of studies and operation records to determine logical replacements

By L. H. Scheifele

Tool and Material Supervisor, Reading Company

The question "Can Modern Machine Tools Cut Repair Costs" could be positively answered in a few short sentences and be justified and proven by the experiences of many present day users of modern machine tools. However, before deciding and recommending which of existing old machine tools should be replaced with modern equipment, the requirements should be carefully studied.

How should this study of requirement be approached and what should be the deciding factors governing the purchase of new equipment. First, we should study our entire operation. Select the key machine in this operation and determine whether or not this machine is producing to its maximum capacity. Having satisfied ourselves on this point, the next thought should be, will a modern machine tool improve production, if so is there sufficient volume of work available to justify its purchase? Many of us who have been associated with machinery most of our lives, have an innate love and admiration for a new machine tool lately designed and equipped with the latest mechanical features. Because of this natural attraction we are very liable to recommend such a machine tool out of sheer admiration for its mechanical appeal, without properly considering whether or not we have sufficient volume of work to warrant its purchase.

Having studied the key operation, the next thought should be, how will the existing supporting or minor machine tools fits into a program faced by a modern machine tool. This factor should be handled in the same manner as previously discussed when considering the key operation.

Having decided which machine tools should be replaced with modern equipment, the next thought is which of the many new types of modern machine tools will best fit into your program.

All of us who are charged with the supervision of machine tools or their operation, should be continually scouting for improved methods and equipment. Unfortunately, this phase of our work is sometimes suppressed by company policy or by our own, allowing matters to take their course, attitude.

And now, if you will pardon me, I would like to relate the experiences of the Reading Company in connection with a comparatively recent machine-tool replacement program.

I need not remind railroad men that along with all other industries the railroads were very drastically affected by the recent business depression. Consequently, it became essential that economies be effected in all departments of railroad organization. Maintenance of equipment ratios were trended downward, while at the same time operating efficiency and equipment design were trended upward. The Reading Company accepted this challenge of a new era, and sought ways and means to meet these two opposite trends. In order to do its full share in effecting economies, the Motive Power Department of Reading Company made a survey of its entire machine tool equipment, beginning early in 1933. This survey disclosed there were 730 machine tools in the Reading Shops whose average age was 30.9 years.

Having carefully studied the machine tools on key operations as well as those on supporting operations, it was quite obvious to us that we could not produce quality workmanship and effect the necessary economies with this type of machine tool equipment. Quality workmanship, more than ever is essential to meet higher train speeds safely and to reduce road failures. Both of these factors improve efficiency and assist in attracting business. Economies and consequent earnings are essential in order that those who finance railroads and industry, may remain interested.

What Equipment Can Be Replaced?

The next problem was to decide which of the obsolete machine tools should be replaced first. This problem was attacked by studying modern machine tools in operation in other railroad shops and kindred industries; also by visits to various mechanical shows and working exhibits. The data obtained from these sources provided the necessary basis for an intelligent machine tool replacement recommendation and estimation of savings which could be effected.

A program recommending the scrapping of 50 machine tools, whose average age was 33 years, and the purchase of 37 machine tools at an estimated cost of $227,000, was submitted to the management. The savings, based on full time operation, i.e. 26 double-shift working days per month, which could be effected with the 37 machine tools recommended, was estimated as 26 per cent. This program was approved March, 1935. Specifications were drawn up and after analyzing many bids, requisitions were submitted during June, July and August of 1935. All 37 machine tools were purchased and in operation by March, 1936. These machines are equipped with various types of cutting tools, each chosen after detail study had proved it to be the most economical for a particular operation.

This might appear to be the happy completion of a fine program. However, we were still confronted with the problem of properly manning the new equipment efficiently in order that their potential savings over the old equipment, might be realized. The ranks of the young mechanics who are most readily adapted to changes in practice and machine tool operation, were depleted on account of seniority rules governing reduction of personnel made necessary by business conditions. Also the apprentice system was inoperative for the same reason. However, by patient supervision and instruction, the older mechanics were trained to operate the new machine tools efficiently.

The natural question at this point, no doubt, is what actual savings have been effected with the 37 new machine tools, how were they arrived at, and how do they compare with the estimated 26 per cent return, based on full time operation?

The first year's required operation of the new machine tools was only 43 per cent of full time operation. In spite of the shortage of work and the fact that workmen had to be gradually accustomed to new methods and tools, the actual savings was 17 per cent. You can readily see that were full time operation available, a savings of approximately 39 per cent could be effected. To date, at no time have these machines worked more than 48 per cent of full time operation, however, the average monthly savings to date have been 20 per cent. At the end of July, 1937, the accumulated savings was $71,319.79. This is 31.4 per cent of the original investment of $227,000.

These savings were determined by placing a production form on each machine. These forms are collected daily and compared with production obtained from the old machines which they replaced.

I would like, at this time, to refer to several machine tools which are outstanding when compared to old equipment which they replaced.

The Reading shop is equipped with three vertical rotary table milling machines, two of which are approximately 30 years old, and one modern machine with a 54-in. table. It requires 24 hrs. to machine two passenger-truck equalizing bars on the old machines. The same items are machined on the new machine in 8 hrs.

Locomotive main-cylinder packing rings are machined on a modern vertical boring mill equipped with side head at 100 ft. per min. on the rough cut and 150 ft. per min. on the finish cut. The machine previously used for this work could only be operated at 60 ft. per min. and frequently failed at this speed.

Metal spray equipment consisting of a steel grit blast cleaning cabinet, spray booth, two spray guns and a converted engine lathe was installed August, 1935, at an approximate cost of $2,800.00. To date the accumulated savings effected with this equipment is $6,689.60.

In addition to the program just referred to, the following additional tools were purchased during the last four years. Ninety-nine portable pneumatic tools, 31 portable electric tools, such as drills, screw drivers, nut runners, etc., 54 miscellaneous machine and portable tools.

Some of this equipment has paid for itself in six to twelve months.

There is one example of an electric crane truck costing $4,800.00 assigned to a Reading Company enginehouse, that has paid for itself after 13 months operation. There is another example of four pneumatic impact wrenches costing $1,000.00 that have effected an accumulated savings of $4,832.00, in two and one-half years.

During the last four years we have also converted a considerable number of lineshaft-drive units to individual motor drives. Eighty-four machine tools have been so converted to date.

Results of Improvements

As the result of this improvement, nineteen 50-hp. lineshaft motors, and 1025 ft. of lineshafting have been retired. In addition to lowering the cost of machine tool power, the removal of lineshafting, line shaft hangers, column brackets, lineshaft motors and countershaft timbers has eliminated the maintenance cost on these items and greatly improved the general appearance of the shops.

The experiences I have just related are amply born out in other railroad shops as well as in other industries. All of us have a daily example of an outstanding achievement brought about by modern machine tools—the automobile. More comfort and safety is built into this product than ever before and at a lower cost to the consumer. This was made possible by modern machine tool equipment. Recently a prominent figure in the automobile industry made the following statement over a nation-wide radio hook-up: During the last eight years $175,000,000 worth of equipment was scrapped by his company and replaced with $217,000,000 worth of new equipment. The result of this policy was increased earning capacity of their employes and lower cost of the finished product to the consumer.

I would like again to emphasize the importance of careful study before submitting recommendations for the purchase of new machine tools. Bear in mind that the men who have the authority to grant an appropriation for such expenditures are not always mechanical men, consequently, the recommendation should be clearly set up in a business-like fashion. The age, condition and productive capacity of the old equipment should be stated. The new equipment should be described in detail and its mechanical and economic advantages clearly stated.

After the new equipment is purchased and in operation, keep accurate records of what has been accomplished in the way of savings or improved workmanship. The data will be invaluable when requesting future new machine tool equipment.

Accident Prevention in the Mechanical Department

Supervisors are key men in training employees—Safety committee an important factor

By R. C. Helwig

Safety Agent, Delaware & Hudson

There is no cure-all for accidents; there is no beaten trail to safety and there is plenty of room for improvement in our own operation as well as in our accident prevention results.

It is generally recognized on all railroads, in fact in all industries, that supervisors are the key men in procuring co-operation among employees, which is necessary, not only for the prevention of accidents, but for general efficiency in operation as well. Men appointed to supervisory positions should fully realize their responsibilities, not only in quantity and quality production, but in economical and safe production as well. They should have the ability to detect unsafe practices and correct them before the accident happens. Just because an operation has been performed many times without accident does not imply that it is a safe method and many accidents are caused by following presumably safe practices which were actually unsafe, but the hazards of which had not been detected.

When a severe injury or a fatality occurs in any shop, the executives of that plant are always keen to do something drastic about accident prevention to avoid a recurrence. However, when a comparatively minor injury occurs, the fact is often overlooked that the seriousness of the results of any accident has nothing whatever to do with its cause and therefore, with its prevention. In other words, the serious injury and the minor injury are usually the result of exactly the same cause and both are important as an indication of the effectiveness of your accident prevention program.

After all, just what is an accident? Is it not something that happened when you did not think it was going to happen? An accident is really a mistake coming to light, and an injury is the result of an accident. Accidents do not always injure people. Statistics show us that there are about 30 accidents to equipment or material to every one that even slightly injures a human being and that there are about 300 minor injuries on the average to one lost-time injury. Strange things happen. One man may fall 30 feet and escape with a few bruises. Another man may slip on a grease spot on the floor or trip over a water hose and fracture an arm or a leg. After the accident happens, you can't control the severity of the injury. To prevent injuries we must prevent accidents and the plant that practices good continuous safety work the year around, directed at minor accidents that occur with more or less frequency in any plant, automatically prevents most serious and fatal accidents.

The Work of the Safety Committee

On the Delaware & Hudson, in all of our larger shops and enginehouses, we have safety committees, probably organized along the same general lines as the committees on your respective railroads. The usual plan is to appoint a safety committeeman for each foreman's gang and it has been my experience that each safety committeeman is just as active and efficient, so far as accident prevention is concerned, as his immediate foreman wants him to be. In other words, I believe that most of us want to do what our particular boss wants us to do and that generally the foreman's attitude toward accident prevention, as in other things, is reflected by the men working under him. For that reason I believe that the supervisor must show by his attitude and actions that he is 100 per cent for safety. This is very important. Can you reasonably expect a man working for you, to carry out safety instructions, if you do not yourself demonstrate by your own actions, that these instructions are not only practical but important? The men working for you are more apt to do what you do rather than what you tell them to do.

A safety committeeman, properly guided by the foreman, can be of considerable help to him, in setting up a proper organization to prevent accidents to the men under his supervision and after all, successful accident prevention, is largely a question of proper organization. Our foremen know that if an accident happens to a man under their supervision they are held responsible; on the other hand, if the men under their supervision work without accidents, they receive the credit for the performance. We feel that a safety record, whether it is good or bad, is the record of the men who made it. It has been our experience that the foreman who considers the safety committeeman as his assistant in preventing accidents to the men under his jurisdiction, has been most successful in his accident-prevention program.

To illustrate: Some of our foremen made it a practice to take their safety committeemen into their confidence and found the opportunity to discuss with them, for a few minutes each day, ways and means of increasing the interest in safety of the men in their gangs. They also solicited from the safety committeemen, any suggestions they might have to offer along this line. Where this method was followed, it was surprising to note the better feeling and greater interest in safety, that developed, with the result that now, pretty generally, this plan is carried out by the foremen.

Gang Meetings

Another plan which was started by the supervisors at one of our larger shops and which is now pretty generally carried out over the whole railroad, is for the foreman and safety committeeman to hold a meeting with the men under their jurisdiction, at regular intervals. This varies, in different locations, depending on the need and local conditions, from a 10- or 15-minute meeting each week to a 30-minute meeting each month. At these meetings, safety matters of interest to the men in their particular line of work are brought up and discussed and suggestions by the men, for eliminating hazards in their work, whether from unsafe conditions or practices, are encouraged. It has seemed to us that greater benefit is derived from these meetings when the discussion is limited to the members of the particular group, so it is only very rarely, and then only for some special reason, that the members of the safety department or other officers of the department involved, attend and talk at these meetings. In the first place, the foreman and the safety committeeman feel that this is their meeting and the responsibility for its success is theirs. In the second place, the general discussion on subjects which may come up

is usually more free when only the members of a particular group who continually work together are present. The minutes of these meetings are recorded and forwarded to the division officer in charge of the particular shop or enginehouse.

At one of the larger enginehouses we found that about three-fourths of the accidents were occurring on the two night tricks—namely, the 3 to 11 and 11 to 7. In view of the fact that about two-thirds of the total number of men were employed on the 7 to 3 trick, it seemed as though the night tricks, with one-third of the men and three-fourths of the accidents, were having more than their fair share of the accidents. There was a safety committee in operation at this point which met at a specified day each month at 1:00 p.m., and which included representatives from the 3 to 11 and 11 to 7 tricks, but the large majority of the members, were from the 7 to 3 trick for reasons which you can readily understand. The master mechanic decided to organize, what he called, a night safety committee, composed only of men from the 3 to 11 and 11 to 7 tricks. The meeting, held separately from the day committee, was called for 10:00 p.m. by the master mechanic, who presided as chairman. The safety committeemen, who ordinarily went to work at 11:00 p.m. came in an hour earlier to attend this meeting and the 3 to 11 members of the committee, were held over until the meeting was concluded. In a very short time after this committee was organized, the large number of accidents on the two night tricks stopped and the injuries per man hours worked on the night trick is just as low or lower than on the 7 to 3 trick.

No Printed Rules

On our railroad we do not have printed safety rules. Without entering into any discussion as to the advantages and disadvantages of printed safety rules, I might say that I have been asked by supervisors from other railroads where safety rules were in effect, "How do you apply discipline for failure to observe safe practices?" The answer obviously is, we don't. However, when I first came to work on the Delaware & Hudson, 24 years ago, one of the first things I learned was, that a man was expected to do as he was told and when he refused to do as he was told, he automatically severed his connection with the company. That still holds true, and an employee must carry out the instructions of his superior, whether those instructions apply to accident prevention or other things in connection with his work. It is true that in rare instances, discipline has been applied by the proper officers for flagrant violations of safety instructions given by the foreman for the necessary protection of a man doing certain kinds of work. In such instances, discipline was administered not for failure to comply with safety rules but for failure to carry out the instructions of his foreman, or in other words, for insubordination.

It seems to me that it is ridiculous for us to assume that a man on our railroad, or any other railroad, gets hurt on purpose. He gets hurt because he or someone else has made a mistake and it is through an organized educational program that we must try to avoid these mistakes. The other day I heard a definition for education which appealed to me. "Education is anything which helps to reduce the cost of experience." It seemed to me that that is an especially appropriate definition for safety education.

The Problem of the Hundredth Man

A long time ago, one of our company surgeons told me that from his experience he had learned that you could get along with 99 out of every 100 men simply by being decent to them and by treating them fairly. The other one man out of the 100, he said, does not understand that kind of treatment and must be talked to in a language that he can understand.

With the average workman, it is not difficult for the foreman, by the use of tact and a friendly attitude, to impress upon him the importance of everybody pulling together to keep men from being injured. A supervisor has a limited number of men and by constant effort will soon have built up a group of men who will take pride in the good safety record of their department and will put forth considerable effort to maintain it. Perhaps this will not include every man under his supervision, but this safety group which he has built up will eventually take care of the others who have not as yet been convinced.

The next question which naturally arises is "What to do about the fellow who is difficult to reach by ordinary methods—this one man in a hundred who has to be talked to in a different language that he can understand?" This is a rather difficult question to answer because it is impossible to lay down a hard and fast rule as to the reaction of each individual under given circumstances. Each case of this kind, I believe, is a problem in itself, which requires study on the part of a supervisor who is personally familiar with the man. One of the things which we have found worth while is an arrangement whereby any safety committeeman, who feels that it will help him in his accident-prevention work to have some fellow employee sit in at one of the safety committee meetings as a visitor, can make either a written or verbal suggestion to the chairman that he be invited to attend the meeting. The chairman then notifies the man to be present at the next meeting. When he gets into the meeting he is not "bawled" out nor belittled in any way, but the chairman explains to him that he has been invited to sit in as a visitor to find out what the safety committee does so that he may be able to assist the committee in their program of preventing accidents in his particular department. He is asked to offer any suggestions that might occur to him and frequently does so. Sometimes the man is appointed as a regular member of the committee and it is the usual experience, that once convinced, he boosts just as hard as he previously knocked.

We have also found that getting three or four other men in the department besides the foreman and safety committeeman—this safety group which the foreman had built up in his department—to broach the subject of accident prevention tactfully whenever the opportunity offers will very often help to convince the fellow who is inclined to be a little stubborn.

Of course, we do have the fellow who it seems practically impossible to convince by any of these methods. Sometimes it is necessary for the foreman to say to this man—"Bill, you are a dangerous man to have around—We have all tried to help you but you don't seem to be willing to go along with us—I am afraid you are going to injure seriously yourself or someone else in the department and I have come to the conclusion that I can no longer assume the responsibility for your actions. You ring out and go in and see the general foreman." The general foreman talks to the man and sometimes takes him in to the division officer in charge at that point, who discusses the situation with the man and his foreman and in a day or two, the man is usually back on his job with an entirely different attitude, receiving very little sympathy from the other men in his department who feel that he deserved whatever he received.

The Goggles Problem

Perhaps another thing which causes difficulty in our accident prevention program is the fact that sometimes

supervision and safety officers are so thoroughly convinced in their own minds that certain safety devices are necessary that they fail to build the necessary foundation before issuing a mandatory order. To illustrate: Most of the officers and supervision on our railroad are thoroughly sold on the idea of eye protection, and in practically every car shop on the railroad, it is mandatory for employees to wear goggles at all times while on duty, with a certain few exceptions such as upholsterers and painters who do not work at places where there is an eye hazard. This was not accomplished without many months of preliminary educational work on the part of supervision, members of safety committees and others interested. This preliminary work was necessary in order to get the majority of the workmen in the same frame of mind as those mentioned, namely, that the use of goggles at all times was a necessary precaution, not only for the man who might be cutting rivets or chipping metal but for every other man working in or passing through a shop where such operations are performed.

We recently had a piece-work inspector who was saved the loss of an eye or at least a serious eye injury while checking a car in one of our larger shops when a shim which was being driven in a door bar ratchet by a car repairer flew and struck the lens of his goggles. To give you another illustration, an appurtenance inspector in an enginehouse went up on top of a locomotive to oil and inspect a bell ringer. When making this inspection, he gave the bell a turn while his face was still quite close to the bell ringer. Something scraped across his goggle lens and cut a gash an inch and a half long on his face below the goggles. Investigation developed that one strand of a double-strand wire, fastened to the bell for the purpose of ringing the bell by hand, had broken and was sticking out unnoticed by the inspector. The wire made a deep scratch across the lens of the goggle and this inspector told me that he was sure that, had he not been wearing his goggles, despite the fact that at the time there seemed to be no apparent eye hazard involved, he would have sustained a very serious eye injury.

Don't Fall Off

I do not recall who first said "Safety Promotion work is like riding a bicycle, stop peddling and you fall off," but it is a thought which might well be kept in mind. It is not what you did yesterday or the day before, or last week, or last year but what you do today, tomorrow and next week, and next year which will decide the success of your accident-prevention program.

Open Forum Session

Hot journals, long runs, tapered bolts and low stocks among the subjects of interest

The entire three-hour session on Wednesday morning was devoted to an open forum during which the discussion centered around questions which had been submitted by the members. The first question had to do with the methods used on different roads for combating the problem of hot engine truck and trailer truck boxes. The replies from several members indicated that the adoption of floating hub liners has been an important factor in the reduction of hot journals. Another beneficial practice brought out is that of relieving the crown brasses above the center line of the axle. The proper adjustment of shoes and wedges has an important influence. One road reported that it had had considerably less hot box trouble on engine trucks as a result of the adoption of a coil-spring engine truck design. The dicussion of the proper methods of locating grease grooves brought out the information, from another road, that it had eliminated grease grooves entirely in order to get as much bearing area as possible.

The second question brought up was "Does it pay to strive for high mileages between shopping?" and "Do long engine runs pay?" The consensus of opinion on both of these questions was in the affirmative. One road, reporting 300,000 miles between shoppings for general repairs, on a certain class of power, indicated that maintenance forces will do a better job on "long-run" locomotives than on those assigned to shorter runs with the result that greater mileage is obtained between shoppings.

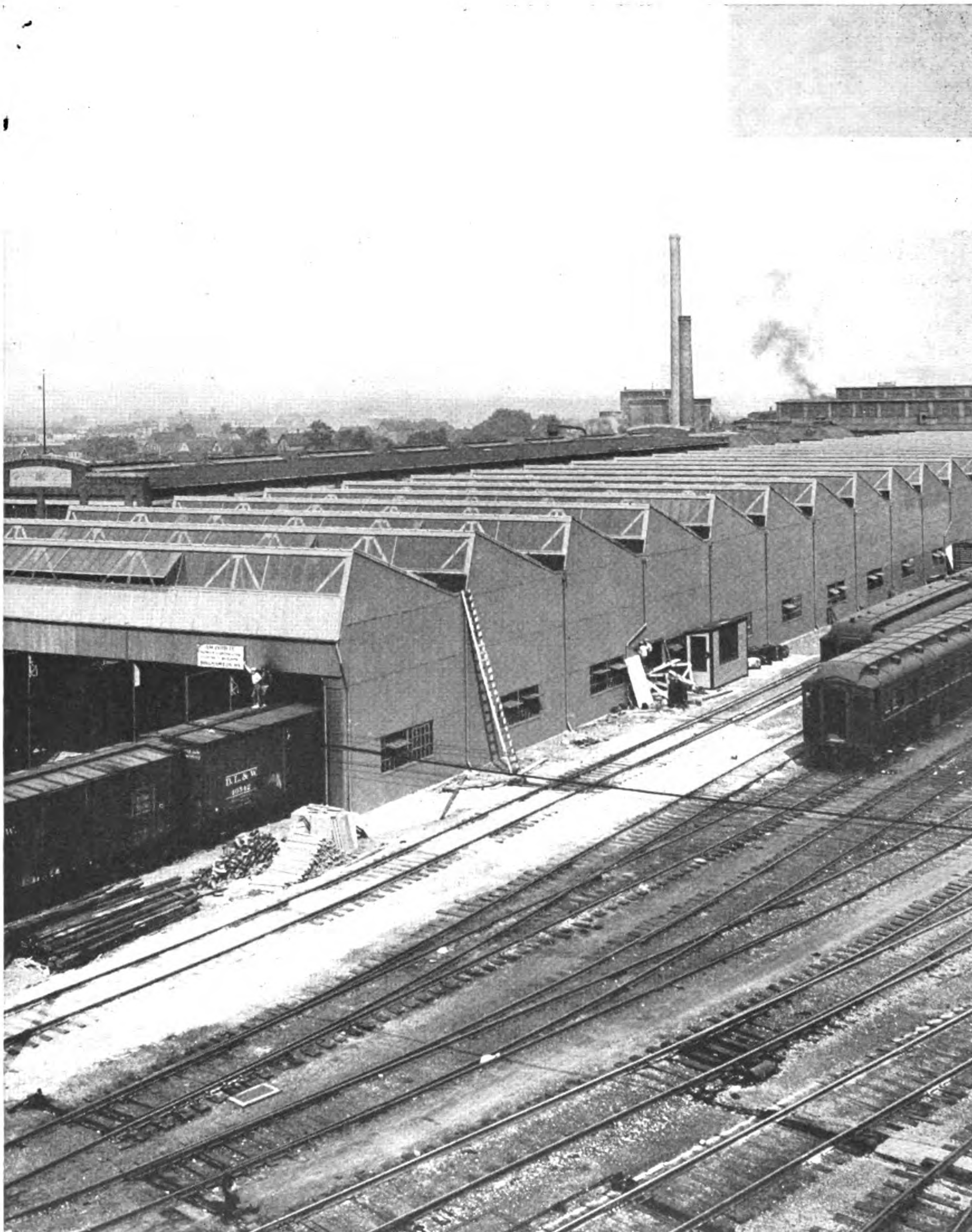
A discussion of a question as to whether any road had found a better material than bronze for shoe and wedge work brought forth no definite conclusions except that careful maintenance was necessary where bronze is used.

Another question brought out discussion on the subject of the best methods for the production of tapered bolts. Many roads, it seems, are now using the practice of producing bolts, on order, to gage sizes. This practice does, however, require that more care be given to the reaming of holes and several speakers told of the methods used to assure accuracy in this work.

A brief discussion of taper fits in driving wheel hubs brought out the fact that the practice of some roads of turning from one to two inches of taper on the ends of axles for convenience in mounting and quartering work had led some inspectors to believe that wheels might be loose. The question of loose wheels then entered the discussion and out of it came the comment, from several members, that many cases of loose wheels are the result of varying tolerances in fitting and that inconsistency in the lubricant used at the mounting press is another important factor.

The concluding question of the forum "Does it pay to maintain stocks at present low levels?" brought forth several comments from members which indicated that maintenance forces are seriously handicapped by shortages of material needed for emergency work. Two representatives of large roads, one a general enginehouse foreman and the other a shop superintendent, came to the defense of the stores department and concluded the discussion by saying that the stores department can only function as well as the mechanical department lets it by keeping it intelligently informed of future needs and that "most storekeepers will stock what you want if you know what you want and will use it after you get it."

GARDENERS.—H. E. Frank, roadmaster's clerk for the Norfolk & Western at Chillicothe, Ohio, claims to have the only night-blooming cereus owned by a railroader. This rare plant is 40 years old, blooms three or four times a year, with 10 to 40 blossoms each time. Lafe Compton, retired conductor for the N. & W. at Kenova, W. Va., also claims the tomato-growing championship among railroaders. His vine, 14 ft. 8 in. high, bore 22 lb. of tomatoes, the largest 2 lb. 7 oz., last year.



Activities of

Car Department Officers' Resumed

Two-day convention held at Chicago was well attended—A future program of mutually helpful work is promised by an enthusiastic membership

After a lapse of seven years the Car Department Officers' Association met in convention at the Hotel Sherman, Chicago, on September 28-29, with a registered attendance of over 250. Except for the discussion of the A.A.R. Rules of Interchange, the program was made up entirely of addresses and papers. A considerable portion of the first session was devoted to business of the association, including the adoption of a new constitution and new by-laws. While the constitution and by-laws were adopted as a whole, they are based on the former laws of the association, revised to meet the changed conditions under which the association will function and the reorganizing necessary because of the long lapse in association activity.

The meeting was called to order by the president, K. F. Nystrom, superintendent car department, Chicago, Milwaukee, St. Paul & Pacific, and the invocation was delivered by B. F. Jamison (Sou.), a member of the Association. Following the presidential address and that of Roy V. Wright, editor of *Railway Mechanical Engineer,* reports of the Auditing and Membership Committees and of the acting secretary-treasurer were presented and accepted. The Auditing Committee presented a report covering the period since the last meeting up to July 31, 1937, showing a deficit of nearly $300. Up to the time of the convention a total membership of about 550 was reported. The secretary-treasurer for the period August 1 to September 27, inclusive, reported a substantial balance on hand at the end of the period but pointed out that it would be insufficient to print the proceedings without receipt of additional membership dues.

During the course of the convention brief addresses were made by V. R. Hawthorne, secretary of the Mechanical Division, Association of American Railroads, and L. B. Rhodes (Vapor Car Heating Co.), vice-president of the Allied Railway Supply Association, Inc.*

The Election of Officers

Under the constitution adopted at this meeting the management of the association's affairs is placed in the hands of a board of directors consisting of a president, four vice-presidents, a secretary-treasurer and fourteen members representing railroad companies, two representing private car companies and two representing railway supply companies. The candidates for these offices are proposed by a nominating committee appointed by the president. The Nominating Committee proposed the following candidates who were unanimously elected: President, K. F. Nystrom, superintendent car department, C.M.St.P.&P.; first vice-president, E. J. Robertson, superintendent car department, M.St.P.&S.S.M.; second vice-president, C. J. Nelson, superintendent of interchange, Chicago Car Interchange Bureau; third vice-president, W. E. Dunham, general superintendent car department, C.&N.W.; fourth vice-president, J. S. Acworth, supervisor of equipment, General American Transportation Corporation; and secretary-treasurer, F. L. Kartheiser, chief clerk, mechanical dept., C. B. & Q.

The board of directors consists of H. H. Urbach, mechanical assistant to executive vice-president, C.B. &Q.; C. Claudy, master car builder, G.T.W.; P. P. Barthelemy, assistant master car builder, G.N.; S. O. Taylor, master car builder, M.P.; G. C. Christy, superintendent car department, I.C.; H. H. Golden, superintendent A.A.R. interchange and accounting, L.&N.; G. E. McCoy, assistant general superintendent motive power and equipment, C.N.; E. M. Wilcox, superintendent of equipment, N.Y.C.; J. E. Keegan, chief car inspector, Penna.; C. E. Strain, superintendent car department, P.M.; John Gogerty, assistant superintendent motive power and machinery, U.P.; J. P. Morris, chief mechanical engineer, A.T.&S.F.; O. F. Davisson, superintendent, Armour Car Lines; J. J. Root, Jr., assistant to vice-president, Union Tank Car Company; J. W. Fogg, vice-president, MacLean-Fogg Lock Nut Company, and L. H. Gillick, assistant to vice-president, Vapor Car Heating Company. The election of officers was held at the morning session September 28.

President Nystrom's Address

A six-point program to assist supervisors in meeting their responsibilities

The Car Department Officers Association held its last Convention August 26, 27 and 28, 1930, at Detroit, Michigan. Seven years have come and gone and no convention has been held because of the world-wide depression and to comply with the wishes of the Association of American Railroads, Mechanical Division, to curtail expenses which a convention would necessitate. The Association of American Railroads has kept a watchful eye on economic conditions and as an improvement has taken place it held a convention at Atlantic

* A paper, "Application of High-Tensile Steels in Car Construction," by A. F. Stuebing, United States Steel Corporation, presented at this meeting, will be published in a later issue.

City this year. The Car Department Officers Association, in common with other Mechanical Associations, was advised that a convention held this fall would have the full moral support of the Association of American Railroads as well as the support of executives of individual railroads.

No organization can remain practically dormant for seven years without a demoralizing effect. Our membership was approximately 2,000 in 1930. Since there was no practical means of holding the membership during the intervening years, no effort was made to do so. In the meantime, the railroads of this continent have undergone many changes. Some of our old staunch members have passed away, while others have retired. Therefore, after very serious deliberation, the officers and board of directors of the Car Department Officers Association have decided to start anew.

With the foregoing explanation, I offer no apology for the program of this convention. The program lacks individual papers on important car-department issues. Obviously, our various committees could not be efficiently restored in the short space of time available to prepare the usual reports. The officers and board of directors felt that old and new members would be better served if a program would consist of addresses which would develop the duties of car-department officers.

At this session, revised by-laws will be submitted which will better serve to cover the functions of our organization. However, by-laws are secondary to the purposes of a live association and I will attempt to outline briefly the purposes of our Association.

Friendliness and Loyalty

The aim of this organization is to have its membership extend from Maine to California, from the northern part of Canada to the most southerly point in Mexico—in other words, to cover this continent. Notwithstanding the immense extent of this territory, we propose to provide a means of getting together at such intervals as the Association of American Railroads may indicate in the future.

We all know from personal experience that we can accomplish our duties more efficiently and with greater ease if we have a personal acquaintance with the men involved on other railroads. Such acquaintance is accomplished through an organization such as ours. There is, to my knowledge, no group of employees as interwoven as car-department employees on this continent. A car-department supervisor employed on the Atlantic coast will take care of and be responsible for a car owned by a railroad on the Pacific coast or vice-versa.

The loyalty of car-department employees is very outstanding. A layman will hardly appreciate a car-department supervisor's loyalty in handling the cars allocated to his inspection or supervision. His ambition to cover and protect the standard of his cars becomes a matter of personal pride and interest, so that, particularly at interchange points, he refers to "my cars." Friendly understanding with member roads and loyalty to the property he serves will be one of the aims of the association.

Interchange of Equipment

In 1867 the Master Car Builders' Association was formed for the object of expediting the movement of cars of various ownerships in interchange. During the intervening seventy years a code of interchange rules has been developed, also rules covering the loading of various commodities. The interchange of equipment throws an added responsibility on the car-department supervisor which is unique and has no parallel in the world. The Code of Interchange Rules, to a car-department employee, is a very sacred document. It involves the necessary repairs and care of any and all cars, regardless of ownership, while in his care.

The bills for repairs to freight-train cars while off line amount to approximately $27,000,000, or 15 per cent of the total cost of repairs to freight-train cars. As the annual repairs to passenger- and freight-train cars on this continent probably amounts to $250,000,000, it is not difficult to visualize the responsibility of the car department. This vast interchange, as we know, is controlled by the Association of American Railroads, which has absolute authority to settle all disputes, amend the rules, and define improvements in equipment. Settlement of disputes by the Association is recognized as final by the courts of law. All this is as it should be, and we, as an association, honor, respect and co-operate with the Association of American Railroads.

Repair Problems

The ownership of cars fluctuates but there are approximately 41,000 passenger-train cars on this continent. The maintenance of passenger-train cars, particularly with the introduction of air-conditioning equipment, high speed, new types of brakes, ever increasing improvements in interior appointments, and persistent demand on sanitation and cleanliness, has in the last few years virtually doubled. Many complicated problems have arisen and the exchange of ideas is a necessity for an economical maintenance operation.

Out of approximately 2,200,000 interchange freight-train cars, railroad and privately owned, in existence on this continent, there are several hundred types of cars and designs, all of which may appear on the railroad you are serving. To give prompt, economical and efficient repairs to cars of foreign ownership is one of the duties of a car-department supervisor and is a perpetual problem common to all of us. This organization will have an open forum at all conventions where problems under this scope will be discussed. Improved facilities and greater efficiency for current repairs on the average repair track and an economical and systematic general repair program in shops are of very vital interest to all car owners.

In the last few years, railroads have been forced to make radical changes in car design. In the meantime, high speed has been introduced requiring different equipment than in the past, both as to weight and other factors. Electric welding has been introduced to a very large extent. Some railroads have begun to build their own equipment and this probably will be extended. Therefore, a comparison of designs, shop facilities and shop methods will be given consideration by this association.

Back-Door Salesmen

Another duty of the car-department officer is to repair and prepare freight cars for various kinds of commodity loading. This requires a minute knowledge of requirements of shippers and I commence to believe that if the car-department on a railroad will measure up to its fullest responsibility, the car-department officers can do more to promote an increase in business on American railroads than any other railroad employee.

In this modern age, we have two types of salesmen—the regular salesman who has entrance through the front door, and another type of salesman known as the back-door salesman. A car-department employee is a back-door salesman. He does not make a sales talk or traffic talk, but comes quietly to the back door—the shipping platform—and inquires if the equipment is satisfactory,

and what he can do to better the service, etc. Recently, at a certain point a railroad had for several years lost the good will of a shipper and, with it, the business. A suggestion was made that the local traffic man, together with the car foreman, pay a visit to the concern and see what could be done. The traffic man advised that, if any soliciting was necessary, he was competent to handle it. But no effort on the traffic man's part was effective; then the car foreman was asked to approach the shipper. He did not go to the front door, but went to the back door and carefully inquired what the requirements in the way of equipment were and asked for a chance to furnish one car, which was given him. The result was that the business was regained one hundred per cent. To be an efficient rear-door salesman requires tact and experience.

An organization like ours would be incomplete if Safety First and the welfare of fellow workers were not jealously safeguarded. Therefore we will stand always for safety and with every available agency promote Safety First.

In conclusion, the Car Department Officers' Association pledges itself to create friendship and better understanding among member roads, to further improved and simplified interchange in complete co-ordination with the Association of American Railroads, study for better and more economical maintenance of passenger- and freight-train cars in daily operation, improve shop practices for repairing cars and the building of new equipment, further promote better selection of equipment for commodity loading and foster the safety and welfare of the large railroad transportation family.

Why a Car Department Officers' Association?

Possibilities of such an organization are very great, if correctly appraised

By Roy V. Wright

Editor, Railway Mechanical Engineer

A well-known member of the Mechanical Division of the Association of American Railroads recently remarked in private that he could see no good reason for the Car Department Officers' Association. He indicated that the Mechanical Division was quite capable of handling the standards and recommended practices relating to the car department, and that it received sufficient help from the local car interchange inspectors' associations and clubs in making its periodical revisions of the interchange rules.

Even assuming the correctness of his statement—and I am not willing to grant it—there still remains a large, one might even say vast area, which is uncovered, the constructive study and treatment of which is quite vital if the car department is to meet successfully the heavy demands which are being made upon it. Here is a department which expends large sums of money on the construction, maintenance and repair of the equipment in its charge. Is its supervisory personnel so well trained and so able that it can get along without those processes which seemingly are essential to all sorts of highly specialized groups in collectively studying tendencies in their fields and in organizing to develop methods which will more effectively meet new and changing conditions?

What has the Mechanical Division to offer, or what has it done to solve the great number of difficult and baffling problems concerned with the operation and management of car repair shops and yards? Where in its records will you find anything about the tools and the facilities required for car construction, repair and maintenance? Where will you look for information or suggestions about the numerous major problems concerned with shop methods? Or how about methods of selecting and training employees, or training the supervision? And yet, the way in which these problems are tackled and handled means a great deal on a dollar-and-cents basis, as to the unit costs of performing the work. Moreover, when we realize the large percentage of the budget which goes to labor casts we cannot fail to recognize the potential savings which may be made available through up-to-date methods of supervision and administration.

Radical changes have been taking place in railroad freight and passenger traffic and in the car department, and this is all the more reason why its leaders must be continually on the alert and must pool their ideas and energies, in order to capitalize to a maximum extent on these tendencies and upon the improvements which are being made.

Car Department Not Static

It seems almost superfluous, in a group of this sort, and yet it may be well briefly to review a few of the high spots in the developments of the past decade and a half. In the freight traffic department we can all recall the paralyzing congestions which occurred more or less periodically with the fluctuations in business prior to 1923. Challenged by this shortcoming, which brought severe criticism upon railroad managements and which, in the opinion of some at least, threatened to bring about government ownership, if not corrected, the American Railway Association, as it was then designated, inaugurated a campaign with certain clearly defined goals for the betterment of the services. This was participated in enthusiastically by the railroads as a whole and brought about surprising and gratifying results.

It resulted, for instance, in better loading of freight cars, higher freight-train speeds with long, continuous runs, and prompt deliveries. Freight trains moved with the same reliability, and in many instances, with almost as high a speed as passenger trains. These efforts clearly focused attention upon maintaining the equipment in such condition that cars would not break down on the road or require setting out at division points for the transfer of loads. It emphasized, as nothing else could, the need of first-class equipment with high standards of care and maintenance—a new conception for which car department officers had been devoutly praying for a long time. Hit-and-miss repair methods with mediocre maintenance and repair facilities, and inadequately trained forces, could not stand up under the pressure, and the place of the car department in economical and efficient operation was considerably enhanced.

Still Another Challenge

The depression naturally slowed up the progress

which was being made in improving the equipment and the organizations in charge of its care and maintenance. On the other hand, certain factors developed in these difficult years which have tended to place still greater emphasis on their importance. Threatened with continued inroads of the highway carriers upon freight traffic, the railroads were driven to devise ways and means of regaining their lost prestige. Better service had to be given and this required still higher standards of physical condition for the equipment, not only that it might travel faster and with greater reliability, but that the damage to the lading caused by defective cars might be reduced to a minimum. Moreover, this high standard of equipment and its maintenance must be furnished at low cost, for legislation and regulation have tended to increase the expenses of operation, and subsidized competition has cut into railroad revenues to a point where there have been little or no net earnings and it has been difficult to secure capital for improvements. This has made it all the more necessary to reduce the costs of maintenance to the lowest possible point, although this, as you know, is nothing new to those who have carried on the responsibilities of the car department administration from its earliest days.

The campaign which was started in 1923 focused attention upon the necessity of providing better repair and maintenance facilities and tools; it stimulated the further development of carefully devised rebuilding and retirement programs, with a view to performing the work in the most efficient and effective manner and eliminating obsolete equipment. It forced into the foreground the need for greater attention to the working personnel and to better supervision. It is sincerely to be regretted that the depression caused a slowing up in these processes. Apprentice training, for instance, where it has been carried on in an efficient way, was practically thrown overboard, except in a very few places.

Here, then, are a number of pressing problems in the department of freight car maintenance which require study and attention, and concerning which the car department officers, collectively, can give a splendid account of themselves if they will co-operate in a statesmanlike approach, through an association of this sort. Summarizing, studies and reports could well be made on the proper selection and training of recruits; of ways and means of improving the efficiency of the supervision; of training and coaching the men now in the service in order that they may hold their own in adapting themselves to new practices and equipment; of the best types of facilities and methods of performing the various classes of work, and of the proper tools to use. These are only a few suggestions of the many vital and practical problems which demand attention; you can readily think of others. New materials and new methods of construction coming into use tend further to intensify the problem.

Obvious Weak Spots

Then, too, no one can gainsay the fact that there are still too many breakdowns on the road and too much damage to equipment and lading, because of the defective condition of the cars, whether it is caused by poor construction or under-maintenance. There is also a large question as to whether the railroads can withstand destructive competition if they must continue to insist upon the unreasonably severe packaging requirements which are demanded by no other type of transportation. Poor condition of equipment, as well as rough handling and gross carelessness on the part of the employees are responsible for this damage. The freight car maintenance department cannot evade its share of the responsibility, and it is a serious one.

Passenger Car Maintenance

The responsibilities of car department officers have increased equally as much in the field of passenger car maintenance as they have in that of freight cars. Stop for a moment and consider what has taken place in passenger traffic in recent years. The private automobile, the motor bus and the airplane have played havoc with railroad passenger traffic.

The situation became desperate, indeed, and yet, fortunately, the tide was turned in the very heart of the depression. Air conditioning, which was started in a small way, spread quickly, even though it was rather crude in some of its early applications. Then came the announcement of the high-speed, streamlined trains. These quickly captured the public imagination and incidentally resulted in the speeding up of passenger services generally. They also jolted the passenger traffic departments and stimulated their imaginations to develop more effective measures for securing new business. It is not surprising, therefore, that the car department is now being called upon not only for new equipment, but for extensive rebuilding and modernization of the older passenger train cars. Great ingenuity is being shown in such modernizing programs, which include the addition of many conveniences and all sorts of gadgets, including better and more scientific lighting.

Higher Standards of Maintenance Demanded

Higher train speeds call for a better type of maintenance, for more critical inspections and for greater attention to many details which are concerned with insuring safe operation. Air conditioning makes possible the maintenance of much cleaner interiors and this in turn has stimulated the introduction of more artistic, comfortable and convenient furnishings and equipment. Like the dog chasing his tail, this has made necessary still higher standards for cleaning the equipment. Always difficult problems, those of cleaning and inspecting the passenger train cars now assume even larger proportions. Is it not an important function of your association to devote much time and energy in striving to determine the best ways and means of maintaining passenger equipment in the very pink of condition, in order to strengthen the railroads in their battle to retain and build up passenger revenues?

Here again, also, are involved the problems of building up and maintaining an ample staff of skilled workers for the inspection, maintenance and repair of the equipment; of discovering and adhering to the best practices in the management of these forces; and of providing and properly arranging the facilities and tools, in order to perform the necessary operations most efficiently. This is no simple or easy task when one considers the changes which are being made in the design and construction of the new equipment and of new specialties which are being added in the interests of faster, safer and more comfortable travel.

The Net Result

As a net result of all these things, the car department faces larger and growing responsibilities. The demands are far more exacting than even a few years ago. Rising costs and keener competition from other forms of transportation make vital higher standards of maintenance and more efficient operation. Many car department officers can point with pride to improved facilities, to the more extended use of welding, for instance; to well-devised schedules of rebuilding and repairing cars, the introduction of straight line methods, etc. On the other hand, much is still to be desired on the part of even those who lead in these respects.

Pooling of ideas and interchange of experiences among department specialists have proved invaluable in the growth and development of American railroads. Study and critical analysis of all of the details concerned with the operation of the car department are vital. Certainly these matters are not now matters of study or concern on the part of the Mechanical Division. Moreover, a review of the transactions of the Car Department Officers' Association or its predecessors before the depression years indicates that it can perform this function to excellent advantage.

Interchange Rules

I have made some reference to the interchange rules. With changes in design, construction and operation of freight cars, these rules are naturally subject to occasional revision. Ordinarily, suggestions for such changes originate with the men on the firing line and are first discussed and recommended by local associations of interchange inspectors and car foremen. They are then passed on to the Arbitration Committee of the Mechanical Division, a committee which, by the way, has always discharged its responsibilities in an exceptionally thorough manner, and which, to a large degree, is responsible for the splendid results obtained from the interchange rules.

Ever since the formation of this association it has been the practice to give a prominent place on its programs to a consideration of possible revisions in the interchange rules, and this would appear to be a wise provision, since the association is made up of the various elements vitally interested in the application of these rules, and represents a national, rather than a local viewpoint. It would seem that it could be of invaluable assistance to the Arbitration Committee in acting as a double check by men of broad experience, in studying and discussing suggested changes before they reach the Arbitration Committee. This is the more important because these rules are now refined to such a great degree that every precaution must be taken to examine thoroughly and most critically any changes which may be suggested.

But there is still another aspect in which this association can be of assistance in connection with the interchange rules. After changes in the rules have been adopted by the Mechanical Division, it is of extreme importance that steps be taken to insure that they are uniformly interpreted. Here the Car Department Officers' Association can render a substantial service, since it can give the changes adopted at the previous meeting of the Mechanical Division more or less careful study prior to its annual meeting, and arrange for a thorough discussion at that meeting as to how they should be applied and interpreted. This function, which has always been a part of the work of this association and its predecessor, the Chief Interchange Car Inspectors' and Car Foremen's Association, can continue to prevent disputes and thus keep down the docket of the Arbitration Committee, just as it has been doing for the past 40 years.

Consolidation of Associations

There has been much talk about the consolidation of the various so-called minor mechanical associations, and certain steps have already been taken in that direction. While this may possibly safely be done to a limited extent, most of the associations are so highly specialized that it is not wise to consider actual consolidation. It is true, on the other hand, that some of the associations now overlap to a certain extent, or, at least, there are common problems in which they may be mutually interested. If this year's practice is continued and several of the associations meet at the same time, with a common exhibit, then it would seem that arrangements could very well be made to provide in some instances for joint sessions on topics of mutual interest to more than one of the groups. Comparing the programs of the associations meeting this week, it is obvious that joint study could wisely be given to eliminating certain overlaps, either by restriction as to the subjects to be covered by each association, or by provision for joint sessions.

Large Place for the Association

There is a large place for the Car Department Officers' Association. This was clearly demonstrated prior to the depression years. Conditions during the past few years have played havoc with all of the associations and some of them have been severely crippled, if not almost entirely dissipated. Railroad officers who must sit in judgment on whether or not their subordinates should affiliate themselves with the various associations, must base their opinions on the type of programs which are submitted and upon the practical results achieved. Those associations which have a real function to perform will survive, if they have the courage, the imagination and the will to press forward with vigor and confidence.

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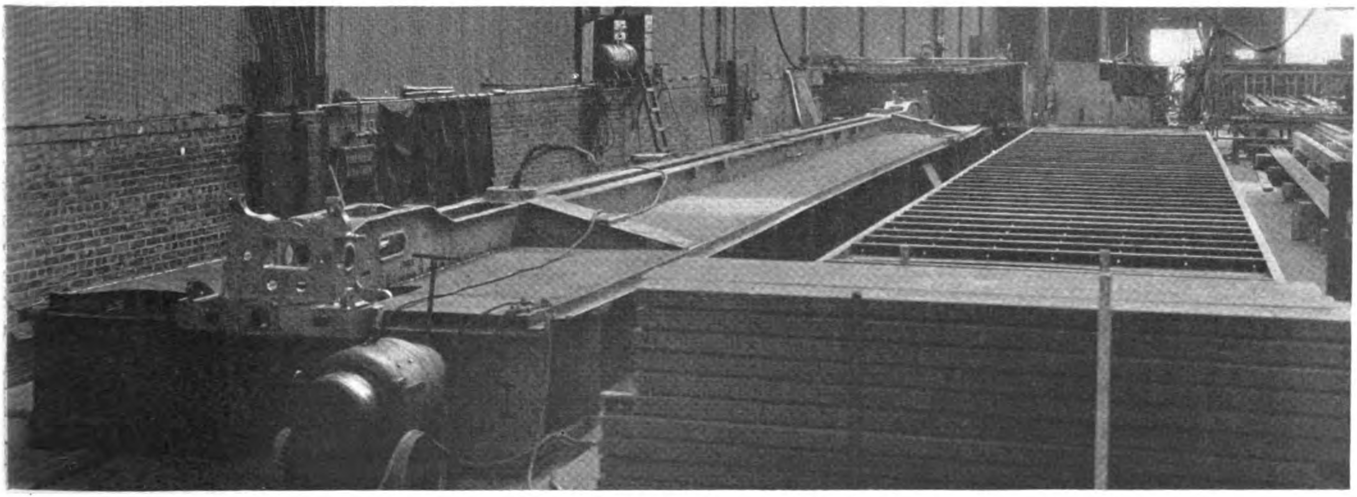

Welding jig for underframes and floor pans—A portable spot welder is used

Relation of Car Department to Safe Train Operation

Improvements in car design and equipment which merit the support of car-department officials

By W. J. Patterson

Director, Bureau of Safety, Interstate Commerce Commission

Mechanical matters require constant consideration to provide for constantly changing operating conditions in order that the safety of employees, travelers and property in transit may be adequately maintained. The Car Department Officers' Association is well equipped to initiate and develop improvements of a mechanical nature, including necessary rules and regulations, and see to it that such improved devices, together with the rules, are utilized and observed.

Personal injuries and property damages are not only direct losses that dissipate earnings but they also tend to divert business and to affect the morale of employees. Safety is greatly desired by the extensive personnel who operate the railroads because it is a personal matter with railroad employees to avoid injury to themselves, relatives, friends and co-workers. To the general public which depends upon and pays the railroads for personal and property transportation, efficient, dependable service with safety is of first importance.

An active interest in safety of railroad operation has also been definitely manifested by the Federal Government. By acts of Congress certain powers have been vested in the Interstate Commerce Commission, and the Bureau of Safety was created to administer laws enacted for the purpose of promoting safety to persons and property. There is, therefore, no apparent opposition to the cause of safety in railroad operation but rather a combined effort to promote and improve it. The greatest possible co-ordination of all the forces that are at work to promote safety is the prime objective for which we are striving.

The actual movement of traffic on railroads involves three major departments: (1) Roadway, including signal system; (2) mechanical and (3) operating. Other general departments in the total organization of a railroad, such as traffic, accounting, etc., are not so directly involved in the physical movement of traffic. Each of the three branches named has a distinct responsibility in the safe and efficient operation of a railroad.

At this meeting of Car Department officials, I shall confine my discussion to some of the problems of the mechanical department, more particularly the car department. In considering and working upon these problems, there has been a high degree of co-operation between the Bureau of Safety and the Association of American Railroads and as a result of this co-operative effort important results have been accomplished.

Car department officials are responsible to the general administrative heads of their companies for the safety of their employees and for providing and maintaining equipment in safe condition to transport commerce moving over their lines. Serious thought and action have been devoted by car-department officials to safeguard employees on duty; this fact is clearly evidenced by the safety-first organizations of most carriers and the excellent results obtained by such organized efforts. And the efforts of car-department officials to improve the safety and efficiency of equipment is reflected in the highly organized Mechanical Division of the Association of American Railroads. Committees of the ablest practical engineers on car construction are constantly at work investigating and testing materials, designs and methods of construction and revising specifications for various elements in car construction with a view to greater safety, economy and efficiency, including trucks, wheels, couplers, draft-gears, air brakes, hand brakes, etc. Such work is ordinarily done in collaboration with the best engineering talent of the manufacturing companies, and the final results should, and generally do, represent the most advanced thought and practice of the time. Within recent years practically all of the main features of car construction have been revised and improved to such an extent that increased train speeds have been made possible and it is probable that these improvements have provided factors of increased safety which have offset the hazards introduced by higher speeds.

Evolution in car construction to improve both safety and efficiency is continually in progress. Improvements of this character when thoroughly proved and adopted should be put into effect as rapidly as possible, or at least within the very liberal periods specified by the Association of American Railroads for the change. Unfortunately this has not occurred in some of the major improvements. In case of the elimination of arch-bar trucks, initiation of a definite program to change to cast steel trucks was delayed by many carriers, apparently little if any effort being made to effect the change within the time specified even after it was clearly established that trucks of this type were not safe for increased loads and higher speeds. Because of these dilatory tactics various extensions of time were granted, but even yet the necessary rate of progress to effect the required change within the present time limit has not been developed by a few carriers and private car lines. Because of the dangers of indiscriminate interchange of cars equipped with arch-bar trucks and the losses sustained by handling carriers, any further extension beyond January 1, 1938, is not justified and has been refused. It is quite probable that some car owners who are not operating carriers may claim that the rule is discriminatory against them because their cars with arch-bar trucks will not be accepted after January 1, 1938, by operating carriers who have heretofore been not only accepting such cars but also assuming responsibility for results in operation even to the extent of reimbursing the owner of the car which, due to failure of an obsolete arch-bar truck, is not only itself destroyed but also causes the destruction of other cars, property and human life as well. It is hardly to be expected, however, that the great majority of operating carriers who have co-operated to eliminate this hazard to safe railroad operation will be required to retreat in their progress for greater safety and continue to accept and handle such cars belonging to a few car owners who have failed to co-operate in this program for increased safety of life and property.

The facts in the development of the standard A.A.R. couplers are well known to you. The reduction from over 100 makes to one standard design, which is safer, more efficient, and economical, was commendable, progressive action. It was brought about by the co-operative efforts of Car Department officials through their

organized channel for action, the Association of American Railroads, and the manufacturers. Unquestionably the results were greatly beneficial to railroad operation, not only as a factor of safety but economically as well.

The revision of wheel standards for greater safety in the last decade is also worthy of mention. The double-plate type of cast-iron wheels was replaced by the improved single-plate type and the specifications of foundry practice were sharply revised to comply with more modern methods and eliminate questionable practices. The application to foreign cars of cast wheels manufactured prior to January 1, 1921, has now been prohibited, thus closing a possible outlet for old wheels that may yet be within the limits of wear. It is to be expected that car-department officials will give very careful attention to the question of application of such old wheels to their own cars in present-day high-speed service.

The establishment of standard draft gear requirements marks an important step to meet a very pressing need for material improvement in this equipment; however, experience may demonstrate the need for revision of the standards which are now in effect, and while these standards will effect a material improvement in new construction the elimination of obsolete and inefficient draft gears on cars now in service presents a major problem for the car departments. Proper design and functioning qualities of draft gears are of vital importance in the safe operation of modern trains at increased speeds.

Maintenance of Draft Gears

Maintenance of draft gears, their attachments and supports, is a matter in which car-department officials are vitally interested and for which they are responsible. During the past three years a great deal has been said about free slack in draft gears. Regulations for "Inspection and maintenance of draft gears and attachments by car owners," submitted by a joint Subcommittee on Couplers and Draft Gears and the Arbitration Committee, was adopted as recommended practice in 1934 and is now shown in the A.A.R. Manual; in January, 1935, the Association of American Railroads requested all car owners to see that these rules are strictly enforced on their own cars in order to improve condition of couplers and draft gears by the elimination of slack in gears as far as possible. Satisfactory improvement was not accomplished under this recommended practice and in December, 1936, attention was again directed to the urgent necessity of complying with the instructions in order to carry out the intent of the recommended practice. Referring to this subject, the Committee on Couplers and Draft Gears, in its report this year, stated: "Your committee cannot urge too strongly the necessity for proper supervision of the repair points to insure that these instructions are being carried out in order to eliminate failures and possible accidents."

Progress has been made in effecting this improvement by a large number of car owners, but there are still many cars in service with draft-gear conditions that are a hazard to safe train operation. Several accidents have been investigated by the Bureau of Safety, which were caused by break-in-two of trains due to knuckles slipping over on account of low coupler, defective or insecure coupler supports and excessive free slack, permitting the coupler to stretch out an excessive distance on a hard pull, so that the coupling face could drop below or be raised above the prescribed limits of height. Regular train-yard inspections just prior to the movement involved in each case disclosed no exceptions.

A coupler not properly supported in a horizontal plane, and drooping downward at head, may cause a break-in-two at any time, and especially so when there are several inches of free slack in addition to the normal coupler travel due to gear compression. The numerous occurrences of slip-overs point to the fact that many couplers which are within the prescribed limits of height when inspected at rest are not supported so that they remain within those limits when stretched out on a hard pull. Bent and loose carrier irons found where excessive slack existed in draft gear also indicates that the excessive stretch-out of the couplers produces a destructive leverage on coupler supports developing bent or insecure carrier irons, causing low couplers and resulting in break-in-twos.

The need for more positive measures to take care of cars of owners who have not responded to present recommended practice is very evident. As an example, in a recent accident investigated by the Bureau of Safety two separate break-in-twos of the same train were found to have been caused by low couplers, bent carrier irons and excessive free slack in couplers. The two cars causing the first break-in-twos were sent to the handling line's nearest shop, where the carrier iron of one car was repaired and a shim applied on the other to adjust the coupler height. The shop foreman found 2¾ in. of free slack in one coupler and 2¼ in. in the other but did nothing about it. The cars which were owned by private lines proceeded on their way with this free slack condition not corrected. A third car, which caused the second break-in-two on the same trip, was inspected on arrival at the terminal and the low coupler was raised by application of two shims, and it also went forward on same date. This was also a private line car; it thereupon moved over six different carriers to its owner, a distance of 1,200 miles or more, with the two shims on the badly bent carrier iron. On arrival at home the car was shopped. The bent carrier iron was replaced but slack in draft gear was not examined or corrected and the car was released for service. It was held for inspection by request of the Bureau of Safety and found to have 2½ in. of free slack in the draft gear at each end of car.

It is evident that the present recommended practice, which merely requires attention to slack at times of air-brake attention by car owners only, will not eliminate many really bad cases of free slack in service. Therefore, it appears that more positive measures are required to deal with this condition. The suggestion has been made, and is here repeated, that serious consideration should be given by car-department officials to a thorough, periodic check of draft gears, their attachments and supports, to determine the coupler travel, free slack, etc., and assure that supports are ample and secure to maintain the coupler within the prescribed limits of height at extreme travel as well as when at rest. The importance of proper condition of draft gears and the possible results of break-in-twos fully warrants such a periodic check and appropriate marking on cars showing that such attention has been given, in a manner similar to inspection of air brakes and journal boxes.

Braking Equipment

Closely associated with the draft-gear question and slack action in train movements is the matter of air brakes. The hazards and destructive results of severe slack action in emergency brake applications have been demonstrated in several accidents investigated by the Bureau of Safety. In at least three such instances recently, the train was buckled, throwing cars out so as to foul a parallel adjacent track. In one instance the train buckled directly into the path of a train on an adjacent track, causing disastrous wreckage of both trains and loss of life. With all other features in good run-

ning condition, the safe speed of trains is largely dependent on adequate means of controlling speed.

The report by the Interstate Commerce Commission in 1924 upon the formal investigation of power brakes and appliances for operating power-brake systems set forth the urgent necessity for improved power brakes and for specifications and requirements covering their functions, maintenance and operation. Extensive research and tests by the Association of American Railroads, the air-brake manufacturers and the Commission led to the development and adoption by the Association of American Railroads of specifications for improved brake equipment which became effective September 1, 1933. Later an A.A.R. rule was adopted, effective January 1, 1935, requiring all freight cars in interchange to be equipped on or before January 1, 1945, with air brakes meeting these specifications, and further requiring each car owner to report progress quarterly to the Association of American Railroads; this information to be filed with the Interstate Commerce Commission.

In accordance with this rule, as of June 30, 1937, 202 railroads and 200 private car lines reported a total of 2,177,158 freight cars owned, of which 163,764, or 7.52 per cent, were equipped with power brakes conforming to the specifications. Thus in 2½ years, or 25 per cent of the total 10-year period alloted for this improvement, we find only 7.52 per cent of cars are so equipped.

The urgent need for the improved air brakes with more rapid serial action is stressed by several recent accidents caused by trains parting and the resulting emergency brake applications. The records show that some car owners have made progress in accordance with the schedule requirements and several have made some progress, but the greater number of car owners do not as yet have any cars so equipped. It is apparent that this important improvement for safety of train operation is not progressing as scheduled. Car owners who are wilfully delaying action on this important improvement for safety may find difficulty in obtaining liberal extensions such as were granted in case of arch-bar trucks. Aggressive action to carry this program through as scheduled is strongly urged.

It is apparent that in recent years, while freight train speeds have materially increased, the effective braking power of many freight cars under load has materially decreased. This was largely caused by the increase of the ratio of load to empty car weight, due to lighter weight in construction made possible by improved materials and methods of construction. The trend of construction to reduce light weight has resulted in many thousands of cars being placed in service with an effective braking power of only 12 to 15 per cent of the gross load on rail, which is not adequate to control trains properly under all conditions. Continued efforts have resulted in the adoption of revised braking ratios on new freight cars of a minimum of 18 per cent and preferably 20 per cent of gross load on rail. Where this cannot be obtained at the permissible maximum of 75 per cent of the light weight of car, the empty and load brake must be used.

Within the last year it became necessary for the Bureau of Safety to stress the fact that a large percentage of hand brakes on passenger train cars were not efficient, due largely to improper maintenance and adjustment. Many were found on which the rods or levers fouled so that an effective application of the hand brake was impossible. Some were inefficient in design and power so that the brake shoes could not be brought into effective contact with wheels. Cooperative action with duly authorized committees led to the adoption at the recent A.A.R. convention of specifications for hand brakes on new passenger train cars and of a set of rules governing the inspection and maintenance of hand brakes on existing passenger train cars. These rules are comprehensive and if followed will provide efficient hand brakes as required by the Safety Appliance Acts. Ample opportunity having thus been provided to correct this condition, violation proceedings under the law should not become necessary in order to bring about compliance.

Conclusion

Improvement in railroad operation, that is, movement of traffic with greater dependability and safety at greater speed, has been and will continue to be the result of gradual evolution of equipment, appliances and practices which made such progress possible. Improvement in rolling stock is one of the important elements

Lightweight cars are made possible by improved materials and construction methods

involved in this progress. The officials of the car department are especially well organized through their various associations, and finally through the Mechanical Division of the Association of American Railroads, to initiate and bring about improvements to cars as they become necessary to meet the demands of traffic. In fact, such progressive action is the past history of the Mechanical Division of the Association of American Railroads and its parent organizations, the American Railway Association and the Master Car Builders Association. Such associations as this of yours are the background of action on rules, standards and practices that are adopted and made effective by action of the A.A.R. for all member lines. The A.A.R. committees on the important car-equipment subjects are generally headed by and composed of car-department officials qualified by knowledge and experience to conduct research work and tests, and to furnish comprehensive and constructive reports on their respective assignments. Car-department officials as a whole are more directly responsible for the rules, practices and standards, promulgated by the A.A.R., governing the condition of and repairs to freight and passenger cars in interchange, than any other group. It naturally follows that those most responsible for the adoption of certain requirements should be the most interested in carrying out those requirements. I urge, therefore, that all car-department officials give their greatest cooperation and support in carrying out the A.A.R. rules adopted in the matter of (1) Eliminating arch-bar trucks (2) equipping cars with improved air brakes by January 1, 1945; (3) revised braking ratios; (4) improved hand brakes on passenger cars, and (5) improvement of draft-gear conditions.

All of these are progressive improvements for greater safety in operation, and having stood the careful consideration and tests of duly constituted committees and then been adopted by the A.A.R., they merit the unqualified support of all car-department officials and member lines to keep the car department in its proper relation to safety and efficiency in all branches of railroad operation.

Car Men's Relation to Loss and Damage to Freight

Concrete suggestions as to car conditions needing correction

By W. L. Ennis

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In glancing over the report of the Association of American Railroads, Freight Claim Division, covering loss and damage claims paid during the year 1936 as compared with 1935, we find that in 1936 the carriers spent $20,920,000 in Loss and Damage claims, as compared with $17,946,000 in 1935, an increase of very nearly three million dollars, or 16.8 per cent. Now here is where car men enter the picture. Of that amount the carriers in 1936 spend $1,208,000 in claims due to defective or unfit equipment. In 1935 they spent $925,-000. You will note there was an increase of $283,000 or 30.6 per cent, very nearly twice the percentage increase as in the general loss and damage bill.

Commodity prices have shown an upward trend for the past two or three years, and it is possible that that upward trend has not stopped, making it doubly necessary for us to take whatever action is necessary to stop that increase, and if possible reduce it.

The amount of money that the railroads spend each year in loss and damage claims is nothing more than a waste, does no one any good and the money could be spent for much more useful purposes, such as improving our property and equipment. However, aside from the monetary issue, we have a much greater item to consider, and one that every employee on the railroad is vitally interested in, because it means his bread and butter. That is the dissatisfaction that is created where we damage or delay freight, and you can rest assured that, if we continue to damage and delay freight, our shippers are going to be dissatisfied with our service and are going to find some other means to transport their freight where it will receive better attention. Naturally the railroads losing business must decrease their expenses. Often the quickest way to get money is to reduce payrolls, and that means taking off employees. Therefore, every employee should be interested in reducing the loss and damage bill.

Classifying Cars for Commodity Loading

The car man is responsible for the classifying of cars for commodity loading. The transportation department depends entirely on the carding on the car, and where the inspector does not give sufficient time and thought in the inspection before carding a car, failing to develop whether it contains any protruding nails, bolts, etc., whether there are rough floor boards, side sheathing and other defects in the floor, roof or sides, liable to cause damage to freight in the way of contamination, he immediately creates a situation that will eventually lead to claim payment. Classifying cars for commodity loading should be confined to the daylight period. If it is not trouble is bound to result, not only in the way of damage to freight but worse yet in the way of a dissatisfied patron, not to speak of the additional expense incident to handling and switching an unfit car in and out of an industry, team track or warehouse.

The Western carriers for the past few months have been handling a large grain crop, and have had considerable difficulty in selecting cars for the loading of bulk grain because of many defects in the cars which, if used, would result in leaks. These defects consist of leaky floors, siding, corners, defective door posts, oil and other stains. The one defect that was outstanding to my mind was that many cars of Eastern and Southeastern ownership which had recently received heavy repairs were not fit for grain loading because the boards used in the decking of the cars were not tongue and groove. The lumber, having shrunk, left openings ranging in size from ⅛ inch to a full inch. Naturally these cars could not be used for grain loading, and some of them had been carded as fit for grain at terminals, moved empty for several hundred miles to the grain territory, and then found unfit for loading without the trouble of considerable recoopering and the use of car liners.

During the past few years many shippers have adopted the so-called unit-tie method of loading freight. This plan involves the strapping of the lading in units in the car, the idea being to create a floating load, giving the units a chance to shift if there be any undue rough handling. One of the first requisites in employing this method of loading is a car with a good level floor. Therefore, in classifying cars for loading with commodities such as enamel ranges and stoves, refrigerators, machinery, barrelled commodities, etc., it is important that a car with a good floor be furnished and care should be taken not to use a car where there is a hump in the floor, which ordinarily means an uneven load and consequent damages.

Cinder- and Smoke-Proof Cars Essential for Some Lading

In the selection of cars intended for the loading of paper, sugar, flour, other mill products, lumber and freight in cartons it is important that a car be selected that is entirely weatherproof, and in that we must include cinder and dirtproof. I have in mind numerous claims, many for very large amounts, which have been paid in the case of lumber, flour, sash and doors, etc., where cinders and smoke have entered car in transit, creating damage to the lading. In most of these cases the entrance of the cinders, rain or snow, occurred through the roof or around the side doors. Here again we are faced with a situation which can only mean one thing in the way of inspection, and that is inspection from the interior of the car with all doors closed, so that we can develop whether holes or openings are present which will permit the entrance of foreign matter causing damage to lading.

The adoption of special equipment for the transportation of automobiles has involved many problems for the car department people, and I can not overemphasize the necessity for a 100 per cent inspection of cars set for loading at the automobile plants. Such inspection should cover fully the various parts of the loading device. Where there is any doubt whatsoever as to whether the device is in condition to transport safely another shipment of automobiles, the car should be bad ordered and given necessary repairs before being used again.

The general thought throughout the country seems to be that any old car is a fit merchandise car, and the practice pretty generally is to card rough box cars for merchandise loading. The value of a car of flour, mill products, etc., is ordinarily $300 to $2,000. We use the best car that we have on the railroad for that commodity. We have every conceivable thing produced in this country in our merchandise cars, and ofttimes the value of a carload of merchandise runs up to $30,000. Nevertheless we use a rough box smeared with oil and grease, coal, etc., with a poor leaky roof and doors, loose decking and side sheathing, for carrying a load of that value.

Equipment Failures Cause Dissatisfied Patrons

One item of expense and dissatisfaction to patrons is the delay item. The A.A.R. Freight Claim Division report of 1936 shows that Class I carriers expended $796,000 in that year as compared with $618,000 in 1935, an increase of $178,000, or 28.8 per cent. This item shows a much greater percentage of increase than the general loss and damage bill. The largest portion of the delay bill is chargeable to fruits and vegetables, meat, dairy products, including butter, eggs, cheese, etc., and livestock. In analyzing many of the claims that are paid as a result of delay to these particular commodities, we find that mechanical defects which caused setting the cars out either in terminals or between terminals for hot boxes, brake rigging, etc., were of such nature that they could and should have been detected on the empty movement to the loading station and prior to the time that the car was loaded. In other words, in the case of equipment employed in the transportation of perishable freight or livestock sufficient attention is not given to the empty equipment on its return to the loading territory. The car inspector apparently assumes the attitude that the car is only an empty, and someone beyond him will see to it that it is thoroughly inspected before it is placed for loading. The result is that often, particularly during the cold months, we find the packing in the journal boxes all pushed up in a wad, with the result that when car reverses movement, a condition has been created wherein hot boxes occur.

Not only do we delay the particular car by setting it out but often we delay the train carrying that car to the extent that it misses its connections. That train may be carrying 50 to 70 perishable or livestock loads that may arrive at destination late. Where we have a decline in market, losses are sustained, and we are called upon to assume them.

With this explanation, I am sure efforts are going to be made to intensify inspection of empty equipment, as well as loaded equipment, and more particularly in the case of cars which we know are going to be loaded with commodities subject to market fluctuation.

Where we are unfortunate enough to have cars containing perishable or livestock set out either between terminals or at terminals because of a mechanical failure or a hot box, every effort should be made to repair that car promptly, and get it started, with a view of making up the time that is lost and get the car to its destination on schedule.

We may feel that many of the items that are resulting in large expenditures of money through the freight-claim channel must happen—that they are incidental to our transportation system and that there is no corrective action necessary. In the Chicago terminals some few years ago we were setting out hundreds of cars containing perishable, and paying out thousands and thousands of dollars in loss and damage claims because of delay, until one of your members, C. J. Nelson, who is now superintendent of the Chicago Car Interchange Bureau, arrived on the scene. Our trouble was immediately minimized, and today we are moving perishable through the Chicago terminals close to 100 per cent on time so far as mechanical defects are concerned. It can be done.

Applying the Loading Rules

Another item of expense that we feel can be improved with your assistance is the $390,000 that the Class I carriers paid out during the year 1936 in the settlement of claims brought about because of damage to shipments of machinery. In an effort to eliminate such claims, we on the Milwaukee have inaugurated a system whereby when a shipper orders a car for machinery loading the agent at the origin station immediately notifies the local car-department representative so that the latter can arrange for an inspection of the machinery at the time the shipper starts to load. The carman being present when the loading starts, will be in position to give the shipper advice as to just what is necessary in the way of blocking, bracing, etc., and thereby not only render real service, but at the same time eliminate the possibility of a claim. At the same time, he furnishes our office with the car number, destination, routing, etc., and we, in turn, pass the information to the various operating divisions as well as connecting lines in the case of inter-

line shipments, asking that the car be given careful handling all the way through to destination. The results generally have been highly satisfactory.

In carrying out our loss-prevention program, we in the claim prevention end of it have been faced for many years with a lack of information as to the exact cause for damage, particularly in the case of carload commodities where the car arrives at its destination with the lading shifted, bracing or blocking displaced, and evidence pointing to hard usage in transit. We know that in many instances where unusual handling is assigned as the cause for damage such is not the case. On the contrary, the shipper or the shipper's forces rather have failed to load and protect the lading in a way that would eliminate damage even though the car did receive ordinary handling.

For instance, we will find that a shipper will go to the expense of purchasing lumber of a suitable quality, free from knots, brash, dry rot, etc., and then will undo his good work by failing to use proper dimension nails or spikes in securing bracing or blocking in the car. In other instances, sufficient thought is not given to the application of the protection, with the result that it does not serve the purpose for which it was intended.

I do not know of anyone on the railroad who is better equipped than a carman to inspect and advise as to the condition of a shipment either in the process of loading or unloading. Once he has developed information indicating the need for corrective action as far as the shipper is concerned, that information should be passed immediately to the loss prevention organization on his railroad, so that action can be taken diplomatically with the shippers.

One place where we have some real work to do is in connection with our inspection of shipments loaded on open top cars, this conclusion being the result of observing inspection activities insofar as this particular class of freight is concerned, and also based upon an analysis of accidents involving such commodities. The carman is usually particularly attentive to the running gear in all cars in the train which he is inspecting. When he comes across an open-top load, he should take sufficient time to examine the manner in which car has been loaded thoroughly, and satisfy himself that adequate and sufficient protection in the way of blocking, bracing, etc., has been applied to keep the shipment from shifting or tipping over. I refer to such shipments as contractor's equipment, clam shells, roadway machinery, tractors, auto trucks (moving on flat cars or in gondolas), automobile frames, welded steel pipe, generators, bridge and structural steel. Vibration plays a part in displacing loads of this nature from their original position, as does unusual handling. In my opinion they should receive more than the ordinary inspection. We have asked our train and engine crews, as well as our agents, to watch loads of this nature, so that we may avoid serious accidents and the payment of large sums of money on such commodities in the way of loss and damage claims.

Reduce Damage in Picking Up Wrecks

Most of you have jurisdiction over the employees assigned to wrecking outfits, and it is your duty from time to time to go out on the railroad and supervise the picking up of derailments or accidents. We have always felt that the use of a lot of good common sense at times like these would save considerable money for the railroad concerned.

The most important consideration in railroading is a main track which will permit operation of trains. At the same time a lot of damage to the cars involved in derailment as well as to the contents can be eliminated by doing the job just a little more carefully. Where it is impossible to rerail or retruck a car without undue delay, then the next best thing is to set it upright alongside the track where the contents can be salvaged later on after the main line has been restored to operation, rather than to turn the car over, causing not only damage to the equipment but, worse yet, to the contents. It has been our experience often times that considerable money could be saved by removing the contents of a derailed car and hauling them by truck to the nearest side track where they could be loaded into other equipment, instead of trying to pick up the car and the contents. Generally speaking, when such action is taken the lading shifts, shearing off a part or all of the superstructure, thereby causing heavy damage to the car and to the lading.

The Neglect of Hidden Defects

An item that I am sure can be worked out by your organization and one that is important is the proper disposition of freight equipment that has been responsible for damage caused by some hidden defect in that car that could not be detected by visual inspection. We have had any number of instances where claims ranging from $300 to $1,000 have been paid because freight was loaded in a car that had a defective roof, doors, etc. The claim-prevention organization in many instances did not hear about the case until the claim was paid and after the car had been unloaded and placed back in freight service.

Where we have a car that is defective and has caused damage, some definite action should be taken to repair it, so that it will not be placed back in service and cause the same damage over and over again. The mere changing of the classification card reducing a car of this nature from a high classification to a lower category does not correct the condition, because the next car inspector who inspects that car will record it to a higher classification, not knowing that a defect exists. This again brings out the importance of the inspector whose duty it is to classify cars for commodity loading, and how important it is that this work be confined to the daylight period, giving him an opportunity to do his job as it should be done. I hope that some plan can be worked out whereby some definite action will be taken either to repair a car that has been responsible for causing a large loss because of some defect, or that the information will be passed on to the line owning the car so that they may take such action.

On the Milwaukee we have asked our agents to mark with white chalk inside of the car the defects, so that they will be readily seen by the car inspector. He is also requested to tell the dispatcher that this particular car has caused damage due to some mechanical defect and to move it to the first repair point where there is a carman located, so that he will be able to make the proper inspection and take the necessary action to correct the condition.

Things to Be Avoided in Rebuilt Cars

New equipment and cars shopped for heavy repairs and rebuilding should be better cars than any we have in service at the present time if we give proper consideration to the various items that are causing loss and damage claims, which I am sure will not increase the cost materially. I have in mind, for instance, many cars equipped with steel threshold plates which have not been countersunk flush with the floor or cut off so that they will not protrude beyond the doorpost. Where steel threshold plates are employed, holes not less than 1½ in. in diameter should be placed 6 in. or 8 in. apart the entire length of the plate, in order to allow shippers to

apply doorway protection. This is also true of steel doorpost plates. In many instances, nailing strips are being applied to the doorpost that protrude as much as 1½ in. beyond the side walls of the car, creating hazards which are bound to result in damage to lading contained in sacks or cartons. The bolts used in securing the decking and siding in many instances protrude beyond the lumber to the extent that they also create additional hazards.

In an effort to counteract condensation in steel roof equipment, which is a very troublesome item from a loss-and-damage standpoint, openings at the eaves and ends of the car have been provided, intended for ventilation. This has not corrected the trouble but to the contrary has created additional opportunities for damage because dust, cinders and the elements enter those openings. I hope that something can be worked out to correct this condition.

The type of door used on many of our box cars is loose and herein lies one of the greatest opportunities for damage to freight due to water, dirt, etc. A door that will completely seal up the doorway opening will go a long way toward reducing our loss and damage bill as well as satisfying our patrons.

The speed to which our freight trains have been stepped up is such that we are handling freight today on schedules that our passenger trains used to travel on. This speed and our present equipment results in vibration that is causing damage to many commodities. I believe that all new equipment, regardless of the character of the car involved, should have stabilized trucks, to reduce vibration. It would be economical from a car maintenance standpoint, as well as from a loss-and-damage prevention standpoint.

Your president, Mr. Nystrom, has made many of the changes that I have enumerated in our equipment, and has many more in mind, so I know that it can be done, and I want to take this opportunity of thanking him for his co-operation.

Remember, in the railroad business we have only one thing to sell, and that is service. When a car is furnished for loading of any commodity and it is not in proper condition safely to transport that shipment to its destination we have not only created damage that is expensive but, worse yet, the dissatisfaction which always follows when freight arrives at its destination in a damaged condition. Surely we must appreciate that our shippers are vitally interested to deliver their products to their customers in first-class condition. Usually they spend large sums of money in preparing their products for shipment in an effort to accomplish this result, and when they arrive in a damaged condition they can not help but feel that the railroads are responsible.

Discussion

In the discussion following Mr. Ennis' paper, the importance of the cotter key as a protection against loss, damage and delays was stressed. The campaign for the improvement in the condition of cotter keys in brake rigging developed on the Richmond, Fredericksburg & Potomac was described. Much has been accomplished by the use of samples of incorrect and correct methods of cotter-key insertion in reducing the frequency with which these keys have to be replaced. For one thing this has reduced inspection delays.

Weaknesses in the construction of auto loaders was brought out as one cause of damage to automobiles in transit which cannot be overcome by inspection prior to loading. Cars on the upper loader are damaged due to weakness and looseness in the sway bolt. Both the top and bottom automobiles are damaged when the members shear at the floor wells. The suggestion was offered that these wells be eliminated and a flush type of floor casting employed instead.

The effect of increased freight-train speeds in increasing loss in damage was also referred to. This has been particularly noticeable in the case of eggs which are developing minute cracks to a much greater extent than ever before.

Economics of Private Freight-Car Operation

Many special types of cars developed to return commodities of great value to the rails

By Leroy Kramer

Vice-President, General American Transportation System

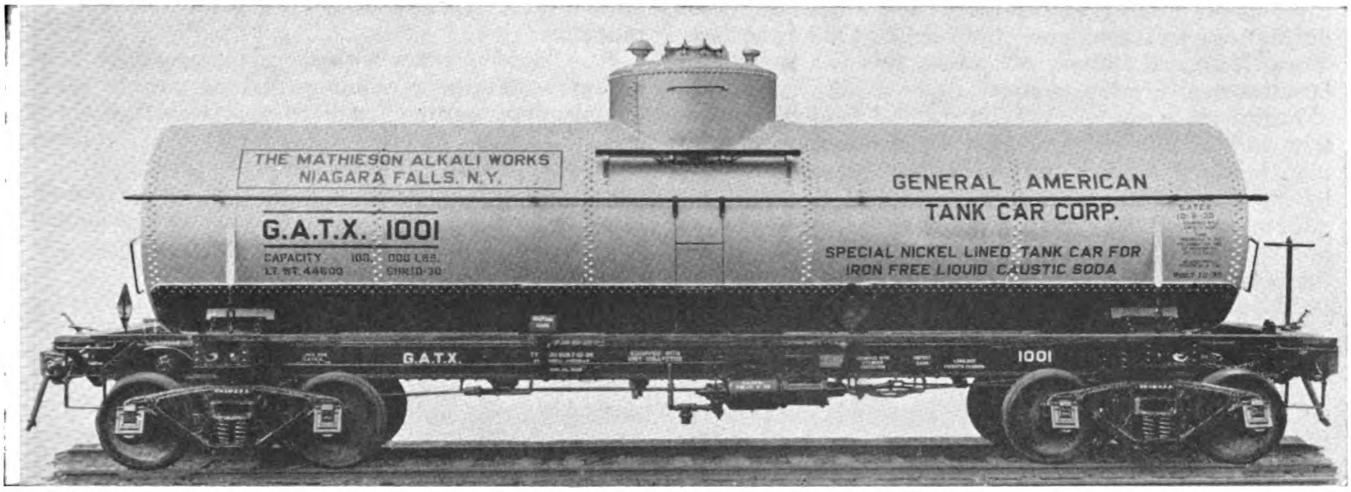
Efficient car department work is an important cog in the intricate operations of this country's great transportation machine. We, in our operations, have much of common interest with you, particularly in those matters of daily occurrence connected with the proper maintaining of cars in running condition.

There is some confusion as to just what types of cars were first built either by shippers or independent owners, but at one time every type of car came in this category. At the present time the private-car supply is largely confined to tank and refrigerator cars, although there are still some stock and open top cars privately owned. Evidently the economics of operation began working against the other types of cars. The railroads began furnishing more completely those standard types which their shippers required, and they have done such a good job of it that it is rare to find a movement of normal commodities that cannot be handled by the standard railway equipment.

65 Types of Tank Cars

On the other hand, and with particular reference to tank cars, there was such a shifting of production from one territory to another, and such a multiplying number of commodities requiring different capacities and types of cars, together with seasonal movements, that it would have proven very burdensome to the railroads to have been compelled to make huge investments to meet these unusual requirements. They did not have the facilities nor the experience adequately to supply the ever-changing conditions, and it is generally agreed that the private cars engaging in these lines of activity have relieved the railroads of very costly and uneconomical operation of special cars.

The private car companies make it their business to exert every effort to furnish equipment that will keep freight on the rails. Having organizations devoted to this purpose, it is natural that they have been able to



Nickel-lined tank car for transporting iron-free liquid caustic soda and other chemicals which attack steel

produce these results because of their constant and patient study of the shippers' requirements and the development of cars to meet those needs.

An interesting angle to car supply is that in a single year our company handled 110 different commodities in tank cars which required the use of 65 types of cars. We are still developing new types to retain or bring back shipments to the rails. No single railroad or group of railroads could possibly justify the ownership of all these various types of cars, nor supply them properly and promptly, and keep them distributed to the various industries and sections of the country to meet the widely varying needs of liquid shippers. With rare exceptions railroads do not own tank cars other than sufficient for their fuel oil requirements, yet no railroad today need suffer any revenue loss from liquid shipments, because they can call on the existing private car companies and get the right type of car on short notice.

Lest someone mentally wonder whether the railroads are paying too great a price for this service, let me remind you that the mileage rate paid by the railroads on tank cars is less than the mileage rate paid by a single passenger per mile and, what is more important, is less than the cost of ownership of these cars. The difference is made up by the shipper agreeing to pay a normal rental, depending on the type of car, and this justifies the creation and operation of tank cars. And also remember that tank cars run on rails and not on roads, so that the revenue in such cars accrues to the railroads, and no mileage is paid when these cars are standing idle.

Refrigerator Cars

What about refrigerator cars? The railroads, either through direct or controlled companies, own about 85 per cent of the refrigerator cars. The remainder are privately owned.

Are these all alike? They are not. Some are specially designed for packing house business, some for dairy products, some for certain fruits and vegetables from territories that differ from cars to handle fruits and vegetables from other territories. Inside lengths, widths, and ice bunker capacities, as well as types of bunkers, vary to meet the different requirements of the products or the shippers.

There cannot be too much emphasis placed upon the necessity for furnishing the shipper the kind of car that he wants. He has his shipping problems and has competition with those who do not ship by rail. He must have a car of the proper length to contain his standard carload, and not too much center bracing which costs money. Ice bunker capacity must suit him, and the car must be capable of giving him the right temperature. He may require cars in a particularly clean condition as compared with those that are used in miscellaneous service. He may not be able to use a car with any odor for certain shipments, and above all, he wants these cars in the right number and at times to suit his convenience. Generally speaking, private car companies have been more attentive to the shippers' requirements, which again has been a tremendous influence in retaining many such shipments on the rails instead of their going to competing truck transportation.

Railroads who own or control cars are generally those which have territories engaged in producing fruits and vegetables in large seasonal quantities. Many other railroads do not have such seasonal crops, but in the normal production of fruits, vegetables, butter, eggs, poultry, packing-house products, etc., need a variety of cars which experience has taught them it is not economical for them to own. In such instances they have leased their requirements from private car companies who furnish the capital and the maintenance, but turn the cars over for operation to the railroads for their distribution and movement. This places them on the same basis competitively with railroad owned or controlled cars.

Some Striking Facts

The following few items indicate the widespread production of perishables, and will doubtless impress you with the fundamental basis of special car operation to meet demands from widely separated sections of the country at various seasons of the year. Again the greatest influence is service to the producer, and this service has to be met in the most economical manner possible.

The most surprising bit of information is the fact that the railroads handle more tonnage of milk and milk products every year than they do of steel. A large volume of this milk was returned from trucks to the railroads when our company developed the glass lined bulk milk car.

Without including homemade or local production, several hundred creameries produce for rail transportation over a billion five hundred million pounds of butter, one-third of this coming from Minnesota, Iowa, and Wisconsin.

No one can even guess the total production of eggs, but the cities of New York, Chicago, Boston and Philadelphia annually receive by rail more than 6,500,000

cases of 30 dozen eggs per case. The largest egg producing state is Washington, followed by California, New York, Iowa and Illinois. Certainly this is a diversified business over a large territory.

Minnesota leads all states in dressed poultry production, and the four cities mentioned above receive between nine hundred million and one billion pounds annually by rail.

Potatoes lead the vegetable and fruit tonnage. Apples are second. Washington originates 40 per cent of all the apples shipped by rail. California ships 70 per cent of the oranges and 99 per cent of the lemons. The southern states—Florida to Arizona—are all increasing their productions rapidly.

Eighty-five per cent of the perishable products handled on rails are grown or produced west and southwest of Chicago and south of the Ohio river. The bulk of this is consumed east and north of those boundaries.

Why Private Car Companies?

The economics of private car companies are generally based on the following reasons:

1. A service need by a shipper or a railroad to protect the loading requirements.
2. The desire and ability to develop and furnish for service those types of cars not generally owned by the railroads.
3. A closer contact with the shipping public and the desire to meet their requirements can only be done by organizations small enough to appreciate the needs of such shippers.
4. The private car companies, in serving their customers, have established standards of service that have been progressive and standards of maintenance that have been generally better than the standards of the railroad.
5. The use of private cars by railroads on a mileage basis is the cheapest thing bought by railroads today. I am entirely familiar with the cost of ownership and operation of railroad freight cars, and I make the above statement with full knowledge that every other commodity bought by the railroad has increased materially in the last few years, averaging about 40 per cent for materials, and yet the railroads are paying the same mileage rate today that they have for several decades. I realize that this rate is a matter of averages. It may produce profit in one direction and losses in another, but on the whole, in good times or bad, the use of cars on a mileage basis has been cheaper to the railroads than it would be if they owned and operated similar types of cars.

A.A.R. Mechanical and Loading Interchange Rules

Factors in interchange inspection which influence operating costs

By C. J. Nelson

Superintendent of Interchange, Chicago Car Interchange Bureau

With the enormous amount of money the railroads have invested in cars it would seem quite proper to assume that the car department is of great importance in the transportation game, and that car-department employees carry far-reaching responsibilities. I believe that meeting and conferring with each other, as on this occasion, will go far toward helping us in this responsibility.

We know that the carmen have not been lagging in progressive activity, and I intend no criticism in this paper to indicate some of the details that might be advantageously handled differently than they are today. I have confined my comments to details having to do with car handling and operation.

I doubt that there is any group of workmen connected with railroading who are governed by nearly as many rules and regulations as are the car inspectors, having in mind such rules as the A.A.R. Mechanical Rules of Interchange, the A.A.R. Loading Rules, the Safety Appliance Regulations, the rules covering the handling of explosives, the railroad clearances, etc.

It requires a well-trained mind to understand and retain them, and failure to do so is bound to result in heavy losses and possible injury or loss of life. That same mind should also be well enough trained to exercise good judgment in cutting cars out of service, and I have, apparently to no avail, constantly endeavored to impress on the minds of all concerned that injudicious shopping of cars is creating enormous losses, but I am still hoping that some kind of united and remedial action will be taken to curtail it.

Time will not permit doing justice to this detail, and I will, therefore, briefly suggest that consideration be given to the following recommendations: (*a*) When failure or wreck occurs on account of a car defect, higher officers should bear in mind that indiscreet or terse criticism might affect the judgment of sub-officers and employees to the extent of making them over technical. (*b*) Have traveling or higher supervisors make periodical surprise checks of repair tracks to ascertain whether or not some of the loaded cars could have continued to points of unloading without repairs. (*c*) Make greater effort to educate present and potential car inspectors, with a view to making them better qualified to properly perform their duties. (*d*) Insist on reasonable time being allowed for inspection.

I was requested to make some comments on interchange, and in doing so, I again call attention to the deplorable fact that the A.A.R. Mechanical Rules of Interchange are, too frequently, being willfully violated. While I could cite many concrete cases, it will probably suffice to use a recent and outstanding example. I refer to revised Rule 36, effective August 1, 1936, which, as you know, prohibits the use of red printing or red background on placards used by the railroads. Realizing that it would be costly to destroy the large stocks of such cards on hand at the time the rule was changed, the Chicago roads were allowed nine months to exhaust them, with the warning that the rule would be literally enforced at the expiration of that time.

While some roads had taken action toward providing proper cards, we discovered, when the rule was finally enforced, that the percentage was small, and that the great majority of all the roads had done practically nothing to meet this requirement. The results were that thousands of defect cards were issued in Chicago, that an enormous amount of time and money was unneces-

sarily spent, that we received bitter protests from all parts of the United States, and that we were repeatedly charged with being over technical.

Furthermore, we know that so-called gentlemen's agreements are in existence at many points, to simply remove the cards from cars, without defect carding, which, of course, means that when the painful penalty is not applied, no action will be taken to eliminate such placards.

It is also a well-known fact that agreements are in effect between some roads to waive important requirements of A. A. R. Rules 3 and 4 in the interchanging of cars between themselves, all of which, to no small extent, defeats the intent of or nullifies the object sought by the Association of American Railroads, and it would seem that this Association should do all within its power to discourage such undesirable practices. I realize that some local conditions might exist which would make it desirable to deviate somewhat from certain rules, but I feel that it should never be allowed without procuring permission from the Association of American Railroads. In fact, considering the time and money spent in developing A.A.R. regulations, I have never been able to understand why the members are breaking faith between themselves in this manner.

In briefly dealing with the Loading Rules, I must again refer to the car inspectors by reason of the varied and fluctuating action they take in connection with the shopping of cars for load adjustments. Some use excellent judgment, while too many others do not, depending mostly on the manner in which they have been instructed.

Many companies simply furnish books of loading rules to their inspectors with instructions to be governed by them, and emphasizing that failing to do so literally will be deemed a serious matter. Under such circumstances inspectors do not dare to pass a load along unless it is secured strictly in accordance with the rules. I have in mind cars shopped for adjustments simply because the blocks, braces, etc., are a fraction smaller than specified in the rules, and cases where large concave blocks, A-braces, etc., are used as substitutes for the much smaller blocks and inferior methods provided for in the rules.

We know of many similar cases where cars are being shopped for adjustments, irrespective of the fact that the loads are intact and perfectly safe. Such action, however, is seldom taken by inspectors who have been properly coached, and who are permitted to exercise their own judgment to a reasonable extent.

While we are entirely justified in being exacting when inspecting loads at shippers plants, so far as enforcing compliance with the rules is concerned, I know that thousands of dollars could be saved, and that many irritable delays could be avoided by the use of common sense in connection with such loads in transit. In other words, I would strongly urge that we refrain from adjusting loads enroute by reason of not being secured exactly in accordance with the rules, if they appear safe enough to continue to destination, with the understanding that each case of improper loading shall be promptly reported, and that immediate action shall be taken with shippers for correction.

Another outstanding example of apparent inefficiency, worthy of consideration, is the preventable penalties the carriers have suffered in connection with the handling of scrap iron. For a number of years loading rule 261 provided that when scrap iron extended above the "car sides or racks," it could be secured with a "sufficient number of strands of ⅛-in. diameter wire to prevent it from falling off." The wording of this rule was somewhat revised in the simplified book of rules (Fig. 115), published in 1934, but without changing the intent. Immediately thereafter, however, the shopping of such loads for transfer or adjustment increased to an alarming extent, which appeared to be mostly due to metal parts being used as substitutes for racks, consisting of boards nailed to wooden stakes.

This, by urgent requests of a number of railroads, resulted in Fig. 115 being changed in 1935 to prohibit the use of such substitutions, but the dangerous loading, transferring and adjusting still continued, and because of this proving unsatisfactory and producing no better results, the 1934 rule was reinstated on January 1, 1937.

V. R. Hawthorne, Secretary, Mechanical Division, Association of American Railroads, knowing that the committee on Loading Rules was at its wits end, had an extensive investigation made by his field men who finally reported that regardless of expense a practically fool-proof rule would be the only remedy, which resulted in the issuance of Circular No. D. V.-902 on May 4, 1937, outlining a further change in Figure 115.

The rule as it now reads would, if rigidly enforced, prove unreasonably expensive and very irritating to shippers, but it is rarely being complied with, and I am now wondering if the 1937 rule should not be restored.

The committee on Loading Rules felt, and I would say properly so, that because there are so many different kinds of scrap iron, a rule permitting such lading being secured as economically as possible would be most desirable, assuming that the railroad men should be well able to decide whether or not it was tied together, or down, thoroughly enough to make falling off the cars in ordinary train handling impossible.

Knowing from experience that a good safe load can be built up to a reasonable height above the top of car sides with such metal parts as pipe, beds, auto chassis, auto wheels and car roofing, by tying them together with wire, I believe that lack of proper action, proper supervision, proper coaching of shippers and employees are the principal reasons for this trouble, rather than the wording of the rule.

If you will make a check, I believe you will find that most of the few scrap dealers who have a book of loading rules know practically nothing about its contents, and that it was either mailed or handed to them without explanation of any kind covering the application of Fig. 115. That is also true with many shippers of other commodities.

It would seem to me that all railroad patrons shipping material on open-top cars should receive a book of loading rules, and that in every case where a rule has been changed, a competent railroad representative should visit each shipper who manufactures the commodity covered, and explain to him why it was revised and what it means. In cases where only one commodity, such as scrap iron is being shipped from a plant, a letter to the shipper, instead of a book of rules, might prove more effective and economical.

Now a few words about the experimental load card shown as Fig. 1 of the loading rules. This card was adopted to assist the Committee on Loading Rules in determining whether or not certain methods of loading freight on open-top cars are sufficiently safe to warrant recommending them to the Association of American Railroads for mandatory rules.

While it seems reasonable to assume that executive officers fully realize the importance of these cards, it is quite evident that the great majority of employees do not, which again reflects the fact that they are not being as thoroughly instructed as they should be. This statement is based on the fact that a few roads are making a fine job of reporting irregularities found on such loads in

transit, or at destinations, often furnishing sketches, photographs, etc., while others are so incomplete and unreliable that they are of no value at all to the committee. In other words, some roads have demonstrated beyond doubt that the necessary details can be correctly reported, if the employees making such reports know just what is desired. It is a rather difficult task to make these reports fully understandable, and few employees, such as car inspectors and agents, can do it without constant guidance by well-versed supervisors. Only a small percentage of these cards are being mailed to Mr. Hawthorne, and it is a well-known fact that they are frequently being ignored by employees who do not fully understand what to do with them.

With the tremendous speeds of our freight trains today, the loading of material on open-top cars has become an exceptionally serious matter, deserving our very best efforts. I know that the Committee on Loading Rules has, in recent years, devoted more time to this than ever before, and I also know that far better results are possible if all the railroads will co-operate as thoroughly as they should.

Another condition which should be of great concern to every railway employee is the destructive effect of excessive impacts of cars in yard switching. Despite the fact that operating officers are continually endeavoring to bring about improvements, I doubt that it is being curtailed to any great extent, if at all.

In the Chicago territory, about 3,500 open-top cars must be placed on shop tracks each year on account of the loads, which had originally been secured in accordance with the loading rules, having been shifted to the extent of making them unsafe to handle in road trains. This only applies to adjustments in interchange, and I believe that figures showing the total number in the United States, and cost, would reveal that the enormous consequential losses are far from being fully realized by the carriers; the figures would, of course, be greatly increased if the closed cars were included.

Many of the commodities involved remained intact when they were subjected to switching impact tests, up to at least 8 m.p.h., under the directions of the Committee on Loading Rules, making it safe to say that these speeds are too often exceeded in what is called ordinary yard switching. If figures could be produced to show the cost of the damage to cars handled in this manner, they would probably prove equally as alarming as those previously referred to.

This being an operating problem, some of you may feel that I am somewhat out of line in bringing it before you, but I am doing so by reason of knowing that carmen can co-operate in this far better than they have in the past.

We can go into most any classification yard and see cars crashing against each other, apparently unobserved by our car inspectors, and about the only time anyone pays any attention to this is when a car is seriously damaged. I fully appreciate how difficult it is to work out a well-defined remedial plan, but I firmly believe that it can be done, and that car-department officers should take more aggressive action in the matter than they are now doing.

C. H. Dietrich, Executive Vice-Chairman, Freight Claim Division of the Association of American Railroads, being much concerned about the large sums of money paid out on account of freight being damaged by improper handling, recently called a meeting at Chicago, and earnestly appealed to the many railroad men present to increase their efforts for better results.

I know that the deep impression he made will result in an energetic campaign being inaugurated, and feel confident that the carmen will fulfil their obligation, so far as co-operation is concerned.

Discussion

Mr. Nelson's paper brought out a lively discussion on the effects of switching impacts and on certain provisions of the loading rules. While high-speed switching impacts were rated as major factors in creating loss in damage claims, the effect of impacts due to uncontrolled slack in road movement came in for a share of the responsibility. At the end of the discussion a resolution was passed calling to the attention of the Association of American Railroads the belief of the Car Department Officers' Association that a study to determine the maximum desirable switching speed, especially for house cars, would be very helpful. While it was generally recognized by those taking part in the discussion that the establishment of such a maximum speed by the Association of American Railroads would be of little value for disciplinary purposes, it could be used effectively in a campaign of education to improve the conditions at present prevailing.

The discussion on the Loading Rules dealt with the handling of poles on flat cars, loading of heavy machinery and light-scrap loading. It was evident that considerable difficulty is being experienced in the shifting of the load where poles are moved on flat cars, with

"While high-speed switching impacts were rated as major factors in creating loss in damage claims, impacts due to uncontrolled slack in road movements came in for a share of the responsibility"

heavy expense for readjusting the loads. More difficulty is experienced where creosoted poles are loaded on bearing strips than when they are loaded on the car floor, although the bearing strips to some extent protect the poles at the bottom of the load from damage. Some improvement in the shifting of these loads was reported where the cars are handling at the head ends of trains. The use of high-tensile bands, applied taut over the load between the end stakes, using the stake pockets for attachment to the car. Where such bands are used it was recommended that shims be applied to protect the poles.

Difficulty has been experienced because of high load concentration with certain heavy machinery, such as drag-line excavators. Cases were cited where this concentration had caused the truck springs on one end of the car to go solid, resulting in derailments. In other cases the concentration of the load through the tractor crawlers at the sides of the cars caused serious distortion of the side sills.

The discussion developed the fact that none of the roads represented at the meeting are complying literally with the scrap rule. Considerable criticism of the rule was voiced so far as it applies to light scrap which must be loaded 4 ft. or 5 ft. above the top of the car in order to get a minimum load and which contains no flat material suitable for building up retaining walls above the car sides. Such loads were said to be unsafe when the binding over the load was depended on because the material settles and the retaining wires become loose.

Address by J. T. Gillick

J. T. Gillick, chief operating officer, C. M. St. P. & P., expressed his satisfaction at the fact that the car men were again getting together for a discussion of the problems of car operation and maintenance. A mismanaged car department, he said, is the most annoying and expensive thing which can be on a railroad. Much intelligent planning is required to adjust car maintenance to fit a fluctuating income and this will be increasingly difficult with the higher costs now imposed on the railroads.

Everyone, he said, takes it out on the railroads; industry passes on increases in its costs, which the railroads have to pay. The railroads, however, cannot pass on increases in their costs and it is, therefore, up to the car department to carry on its functions without increasing costs. To accomplish this, he said, there must be an exchange of ideas such as is provided by the convention of the association. Among the agencies which are available for the assistance of the car department in accomplishing its difficult objective he mentioned the increase in the employment of welding, the use of power jacks and others which are effective in saving time and can be used for the reclamation of material.

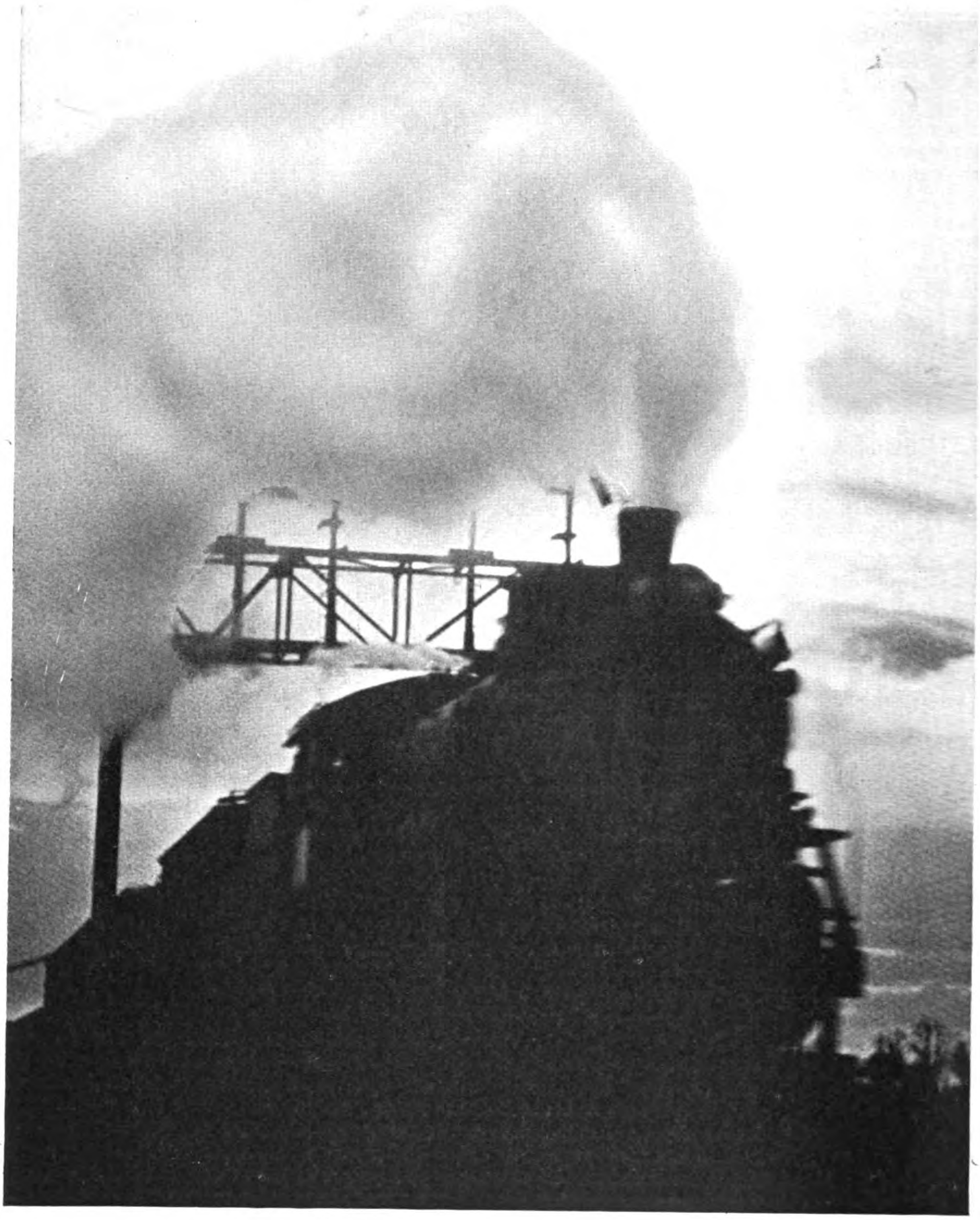
Mr. Gillick held forth no hope of a rosy future for the car men. With freight trains operating at passenger-train speeds, he said that more attention must be given to the condition of air brakes and trucks; there must be a more rigid inspection of draft gears and, while the journal box situation has improved in recent years, it is still far from satisfactory. He cited the changes in passenger-car equipment which are such that he was not sure whether a car repair man or a watch maker were most needed. He pointed out the tremendous importance that attention to little things plays in the successful operation of passenger trains at speeds of 100 miles an hour if interruptions of the performance are to be prevented, and always the cost must be controlled. To accomplish all these things, he said, was expecting a great deal. He expressed his confidence, however, in the car men of the country to meet the new situation as successfully as they have always met their problems in the past.

Discussion of the Interchange Rules

The discussion of the Interchange Rules was led by M. E. Fitzgerald, general car inspector, C. & E. I. In opening the discussion Mr. Fitzgerald spoke of the difficulty of securing complete adherence to rules violations of which are accompanied by penalties. It was his suggestion that the work of the field checking committee of the Mechanical Division, Association of American Railroads, be extended to other phases of the observance of the Interchange Rules than billing. The surprise element in such a system of checking he thought would increase the respect with which the rules are observed just as it had increased the care exercised in rendering bills which conform with the work done. One of the speakers during the discussion asserted that the field committee is working along the line suggested.

For the purpose of effectively bringing out changes needed in the rules, Mr. Fitzgerald suggested that an A.A.R. committee be appointed by the Car Department Officers' Association to seek proposals for changes on the part of the roads represented in its membership, to study and bring these changes before the executive board of the association, and then to present its proposals on the floor of the convention for discussion. Changes adopted by the association following this procedure would then be proposed to the Mechanical Division by the association. On motion, the suggestion for the appointment of such a committee was adopted.

Break-in-twos caused by drooping couplers, and slack in draft gears were the subjects of a considerable part of the discussion which followed Mr. Fitzgerald's presentation. The general practice of shimming up truck springs to restore the height of drooping couplers was considered unsatisfactory by one member, because it did not correct the coupler condition. The coupler still remained out of line, thus being subjected to damage and subjecting the draft gear to abusive treatment. A number of break-in-twos were reported in which the distance from the top of the coupler shank to the striking casting was 2¾ in., instead of the normal ¾ in., permitting the couplers to creep up and slip by. The speaker advocated the use of shims on the carrier iron, rather than in the truck, and also suggested the spot welding of a suitable shim on top of the shank in cases of excessive play between the coupler shank and striking casting. Another member, however, questioned whether it might not be necessary to anneal the coupler if any welding were done upon it. Several speakers expressed the opinion that it was time for the adoption of a rule on draft-gear inspection.



First Meeting of

Fuel and Traveling Engineers

Four-day convention held at Chicago is notable for the number of addresses and committee reports presented, and range of subjects covered

ASSOCIATION since the amalgamation of the two parent associations was held in the Hotel Sherman, Chicago, September 28 to October 1, with a total registration of railroad members and guests of 494. The meeting was under the direction of President J. D. Clark, fuel supervisor, Chesapeake & Ohio, who said in his opening remarks that the union of these two groups was the greatest step ever taken by either in furthering their mutual objective of conserving fuel and promoting and improving the efficiency of locomotive service.

This objective was unquestionably furthered to a substantial degree by the constructive program of individual papers and committee reports* provided by the officers of the association, with all details worked out and co-ordinated through the effective efforts of Secretary-Treasurer T. Duff Smith. Special features included addresses by M. J. Gormley, executive assistant, Association of American Railroads; Roy V. Wright, editor, *Railway Mechanical Engineer;* W. H. Flynn, general superintendent motive power and rolling stock, New York Central; L. K. Sillcox, first vice-president, New York Air Brake Company†; and Eugene McAuliffe, special representative, Union Pacific. Owing to unavoidable absence from the meeting, Mr. Flynn's address was read by A. A. Raymond, superintendent fuel and locomotive performance, New York Central.

One of the high points of the convention from a human standpoint was the address by Mr. McAuliffe, who was responsible probably more than any other one man for the founding of the original International Railway Fuel Association in 1909. Mr. McAuliffe intentionally avoided discussing the technical side of railway fuel used and reminisced regarding men responsible for and events leading up to the development of this association which has proved such an important factor in railway fuel conservation efforts.

Election of Officers and Executive-Committee Members

Officers elected for the ensuing year were: President, J. C. Lewis, road foreman of engines, Richmond, Fredericksburg & Potomac, Richmond, Va.; vice-president, G. M. Boh, district road foreman of engines, Erie, Hornell, N. Y.; J. R. Jackson, engineer of tests, Missouri Pacific, St. Louis, Mo.; and A. A. Raymond, superintendent fuel and locomotive performance, New York Central, Buffalo, N. Y. Executive committee members elected for two years are W. H. Davies, superintendent of air brakes, Wabash, Decatur, Ill.; E. E. Ramey, fuel engineer, Baltimore & Ohio, Baltimore, Md.; W. C. Shove, general road foreman of engines, New York, New Haven & Hartford, New Haven, Conn., and R. S. Twogood, assistant engineer, Southern Pacific, San Francisco, Cal. Executive committee members elected for one year are: L. E. Dix, fuel supervisor, Texas & Pacific, Dallas, Tex.; J. J. Kane, road foreman of engines, Lehigh Valley, Sayre, Pa.; G. H. Likert, fuel engineer, Union Pacific, Omaha, Neb., and C. N. Page, supervisor fuel, Lehigh Valley, Bethlehem, Pa.

Address by M. J. Gormley

A feature of the first day's session was an address "Relations of Fuel Supervisors and Traveling Engineers to Economy of Railroad Operation" by M. J. Gormley, executive assistant, Association of American Railroads. Mr. Gormley said that the railroads are the largest buying agency in the United States and in 1936 spent more than $800,000,000 for fuel, materials and supplies, one-third of which was for fuel. The remarkable progress in the economical use of fuel, Mr. Gormley said, is indicated by the fact that, in freight service, each ton of fuel produced 12,452 gross ton-miles in 1932, this figure being increased to 16,746 gross ton-miles in 1936, an increase of 34.5 per cent in efficiency. In passenger service one ton of fuel produced 110.8 passenger-train car miles in 1923 and 130.4 car miles in 1936, an increase of 17.7 per cent in fuel efficiency.

Reduced to the simplest terms, the railways in 1936 moved one ton of freight equipment and lading a distance of one mile for each 1.4 ounces of fuel in 1936 which may be compared with 2.9 ounces in 1923. Mr. Gormley credited this greatly increased efficiency to improved design and construction of locomotives, application of the latest scientific methods of firing, reduction in road delays by reason of improved operating methods and increased train lengths and the effective work of railway personnel in all departments.

With reference to the 70-car train limit bill which passed the United States Senate at the last session, Mr. Gormley said that this is a make work measure and not a safety measure, and that no one knows better than fuel and traveling engineers how much this measure, if adopted, will cost the railroads. He referred to the development and application of the Type AB brake which greatly adds to the facility of train operation and reduces the possibility of injuries due to slack in long trains and said that one of the railroads having the longest trains now has over 40 per cent of its cars equipped with this type of brake. He stressed the great reduction in fuel efficiency which will result from

* One of these reports, "Steam Turbine and Condensing Locomotives," will be published in a later issue.

† The paper "Things to Come in Transportation," by L. K. Sillcox, will be published in a later issue.

handling trains of 70 cars with modern locomotives.

In closing his address, Mr. Gormley emphasized the importance of securing an adequate public appreciation of railway problems and achievements and outlined some of the work now being done along this line by the Association of American Railroads. As regards the responsibility of individual railroad men in fostering a favorable public opinion, he said, "Every railroad man in the country should acquaint himself with the facts about American railroads and should make an honest, constant attempt to pass along these facts to all the people with whom he comes in contact and it would not be long before a big part of our present-day public relations job would be accomplished. We have the best product of its kind available, our prices are fair, and we have an encouraging degree of confidence from the public. Your association has unusual opportunities to present the story of the industry to important people."

Utilization and Availability of Locomotives

Statistical information on power utilization indicates that there is room for improvement

By W. H. Flynn

General Superintendent of Motive Power and Rolling Stock, New York Central System

The subject of locomotive utilization is not a new one and I question if I will be able to add any thoughts to the mass of information which has been presented to this and similar organizations. However, I believe the general subject is of such importance that those of us who are trying to perpetuate successful railroad operation should continually bear it in mind.

Economics

You realize that the locomotive, either in its form as a Diesel, electric or steam unit or in its form as a motor rail car, makes by its production the revenues which accrue to the carriers from operations. The high cost of these units is a familiar subject and only by the maximum utilization can we expect to receive, because of those high costs, a proper return upon the investment. The purchase price of a locomotive, of course, can be prorated with respect to its revenue earning capacity throughout its life but in addition to the high initial cost we are confronted constantly by maintenance costs which likewise must be converted into revenue. When a locomotive is placed in the back shop for heavy repairs and an expenditure of from $5,000 to $10,000 is made thereon, the sooner we are able to run out those repairs the sooner the revenues accruing therefrom are absorbed among the incomes of the carrier.

Utilization and Availability

Before further discussion of the item of utilization, I desire to call attention to the difference between the terms "utilization" and "availability," as I feel that this is of primary importance, in view of the comparisons which are often made between different types of power. Utilization is the actual performance obtained from locomotives and is necessarily a combination of the mechanical condition of the individual unit to perform service and the readiness of that service to be performed. On the other hand, availability is used commonly to express simply the condition of the unit being ready to perform service, giving no consideration as to whether or not such service is there to be performed. Were records available, there is no question in my mind but that the steam locomotive today would indicate a very improved availability as compared with a rather discouraging utilization which is charged against it.

The Effect of Design Upon Utilization

The maximum in utilization of the steam locomotive should begin with the design of the individual unit; each component part thereof must be considered with that thought in mind, weighing the advantages and disadvantages, taking into consideration, of course, the ultimate economics of the situation. Boilers should be designed so as to provide ample grate areas and firebox volumes so that fuel consumption rates can be maintained at a minimum consistent with service demands; this tends toward cleaner fires and assists materially in increasing the length of locomotive runs and decreasing ash-pit time.

Close attention should be given to the economics involved in connection with roller bearings, since this equipment has done much toward eliminating hot journals, and reducing attention required at engine terminals, thereby increasing availability, and consequently increasing the utilization of the unit. Similar treatment for pin bearings appears to be quite close at hand, indicating that we may be rapidly approaching the day when we need have little fear of delays and detentions attributable to hot pins and bearings.

Another feature of locomotive design which has an important bearing on utilization is the introduction of lightweight reciprocating parts, rotating parts and motion work of high-tensile steel, which reduce by as much as 50 per cent the dynamic augment on modern power. This reduction in dynamic augment has been looked upon largely as of maximum benefit to the track structure. However, each blow that is transmitted to the rail by the locomotive sets up within that locomotive tremendous forces and vibrations which will be reflected in broken parts and failures, making necessary repairs which decrease the availability of the unit.

The designer must give serious consideration to the locomotive's lubrication problems and provide reliable accessibly located automatic lubrication devices which require a minimum amount of time to place in serviceable condition when attention is necessary.

The locomotive should be furnished with sufficient supplies, fuel and water so both freight and passenger schedules, which are being tightened continuously, can be consummated without undue delay.

It is also well for our friends among the specialty companies to bear in mind this item of utilization and design their equipment so that it will require a minimum of attention and be completely accessible when attention becomes necessary.

Long Locomotive Runs

Extended locomotive runs, in both passenger and freight service, have done more toward increasing utilization of the unit than any other single activity. The

success of long runs in passenger service where schedules are most exacting has been pronounced and it seems that a continued effort along these lines in connection with freight operations should pay handsome dividends. You are all familiar with the difficulties that we experience in endeavoring to lengthen freight-locomotive runs, but we should not allow these difficulties to deter us from continually striving toward that end. The longer freight-locomotive run is ofttimes interfered with by lack of fuel and water capacity, by operating delays incident to locomotive movements around terminals, by different classes of power interfering with the smooth engine-terminal performance, by the lack of air lines in yards and the resultant delay to road engines used for pumping train lines, and numerous similar conditions. Nevertheless, real cooperation between departments and an intelligent analysis of each individual situation will, I believe, bring results well worth the effort toward decreasing the amount of power necessary to move a given amount of traffic.

Attempts have been made to relay freight locomotives at many terminals in lieu of running them through such terminals, and while this provides improved utilization as compared with the former method of operation wherein each locomotive was sent to the enginehouse and placed in pool, such relaying is not as advantageous from the utilization standpoint as when the locomotives are operated through these terminals. Studies which we have made comparing the two methods of operation indicate that for every six trains operated by relaying locomotives, one additional locomotive each 24 hours is required over the operation of these units through the terminals. Coal and water facilities may be necessary at terminals in order to provide the necessary supplies for the through running movements.

Repairs

There is a very definite relationship between the utilization factor and the policy of the carrier with respect to locomotive repairs. Involved in this phase of the subject is that old question of the type of repairs which should be accomplished in the back shops. It is my belief that our back shops should be equipped with modern heavy tools in such a manner that heavy repairs can be accomplished in the minimum time, and it goes without saying that such back-shop repairs must be of the highest quality.

When the locomotive has been placed in service after shopping, it should be maintained until the next shopping period by means of periodic inspections. The length of time between periods and the activity at these inspections depends upon the class of power involved, its overall mileage between back-shop repairs, and the quality of the back-shop repairs and periodic inspections. Properly organized and policed power treated in this manner should run between periodic inspections with very little attention other than the necessary cleaning of fires, inspection, lubrication and washout requirements.

Water Treatment

During recent years there has been considerable progress in the methods for treating boiler feedwater which has resulted in decreasing boiler scale and sediment and thereby extending washout periods. We are, of course, required by the Interstate Commerce Commission to wash locomotive boilers every 30 days, but I believe it is not too optimistic to look forward to the time when boiler waters may be so treated that the locomotives may be given an opportunity to run for periods considerably in excess of 30 days without requiring a boiler wash. The geographic location of any particular carrier and the economics of water treatment, of course, enter into the possibilities to which I refer.

Surplus Power at the Enginehouse

Exceedingly valuable information pertaining to this subject can be developed by charting enginehouse performance for the different classes of power handled, basing such charts upon the arrival and departure time of each class of locomotives involved. The results obtained from studies of such charts would indicate quite definitely the normal turning time of any particular class of locomotives at the particular enginehouse. This normal turning time may vary during the days of the week because of fluctuations in business. However, the unit of turning time that is arrived at can be set up as a yard stick to measure the performance, and having developed such a yard stick it is necessary, of course, to follow the item from day to day with the enginehouse forces in order to be sure, on one hand, that a sufficient amount of power to protect the service is available, and, on the other hand, that surplus power is quickly stored.

Statistics

A review of the 1936 statistics as presented by the A.A.R. Committee on the Utilization of Locomotives indicates an average of approximately 260 miles per day in passenger service, 150 miles per day in freight serv-

"A. A. R. statistics on utilization of locomotives indicate an average of 260 miles per day in passenger service"

ice, and 15 hours per day in switching service as the most satisfactory utilization that is obtained by any of the larger American railroads. These figures, converted to monthly in lieu of daily performance, indicate 7,800 miles in passenger service, 4,500 miles in freight service and 2,700 miles in switching service. However, studies which have been made of individual types of locomotives have produced for the corresponding services 12,000, 7,500 and 3,000 miles per month, respectively.

When a locomotive runs 12,000 miles per month in passenger service, assuming an average speed of 45 m.p.h., it is earning revenue only nine hours per day and the remaining fifteen hours per day are spent at engine terminals either udergoing inspection and repairs or awaiting call. Similar calculations for freight service produce a working period of ten hours a day, and in switching service a working period of 16 hours a day. These figures indicate clearly that there is still considerable room for improvement from the standpoint of utilization of this expensive equipment. Studies of utilization for the seven-year period 1929 to 1936, inclusive, indicate that in both passenger and freight service there has been an approximate improvement in mileage per day of one per cent per year, this percentage referring to the entire group of American railroads and indicating clearly a trend in the right direction, although progress has been exceedingly slow. A study of the statistical information dealing with the utilization of power indicates that there is considerable room for improvement. and strict attention to design features, long engine runs, back-shop and periodic repairs, prompt handling and turning at terminals, and cooperative assistance between departments should assist materially toward improving this important feature of railroad operation.

The Influence of Higher Aesthetic Standards

Tendencies in changing attitudes of the public demand consideration

By Roy V. Wright

Editor, Railway Mechanical Engineer

We live in a wonderful country and a remarkable age. Advancing in a comparatively short time from a crude, pioneer stage in a territory of vast area and widely extended frontiers, and taking advantage of the marvelous developments of applied science in utilizing our natural resources, our people have achieved standards of material welfare far beyond the wildest imaginations of our great-great-grandfathers. In this respect we lead the rest of the world by a comfortable margin. As individuals, however, we are so deeply involved in the details of our own individual tasks or assignments that too frequently we fail to grasp the full significance of what is taking place in a large way; and yet, as men engaged in a fundamental and vital activity we cannot afford to overlook changes which are constantly taking place in public attitudes or likings and which may severely react upon the fortunes of the railroads, if they are not promptly recognized and capitalized upon.

Objectionable Smoke and Noise

We, as railroad men, take a keen pride in the locomotive, with its tremendous power and its ruggedness. To most of us the steam locomotive is a thing of real beauty, and in this attitude great numbers of non-railroaders are in hearty accord. On the other hand, the steam locomotive, particularly when coal-fired, gives offense to many people because of the smoke and dirt which are characteristic of its operation and its periods of idleness in terminals. It must be admitted that substantial progress has been made in the past decade in reducing the amount of black smoke which is showered over our communities. And yet, unfortunately, there still remains much which we must admit is open to criticism and which gives offense to members of the community, whose good will is sorely needed in these days.

Electrification of a few railroads in metropolitan centers has been helpful in eliminating or reducing these nuisances, and yet, within the week I have seen a through passenger train, drawn by a steam locomotive, which was belching out great clouds of dense, black smoke in the center of a high grade residential community—and this on a road which proudly boasts of its electrically operated suburban trains in the same district. I saw a realtor swear under his breath as he witnessed this desecration. With some considerable feeling he remarked, "They don't seem to give any attention to the smoke nuisance from steam locomotives operating their freight trains and their through passenger trains, since they have electrified their suburban service."

Steam Locomotives Still Going Strong

I realize that many people firmly believe that the steam locomotive is on the way out and that we will not much longer be subjected to these nuisances. We, as railroad men, however, know that this is not true and that we will continue to have to deal with the steam locomotive for a long time to come. Some of you recall that thirty-odd years ago certain people were prophesying with considerable confidence that the steam locomotive would be replaced by the electric locomotive within 10 years of that time, but the "old reliable" still remains with us. Proponents of the Diesel engine are today almost equally enthusiastic in their claims. Possibly some of you may have read the section on transportation in the report on Technological Trends and National Policy which was recently made to the National Resources Committee. Here are some extracts from it:

"Looking forward to a freight traffic increasing only slowly, at best, beyond the 1926-28 levels, the bulk of railroad freight will be hauled by steam locomotives."

Another sentence in the report reads: "The steam locomotive will likely prove adequate to the general demands of the railroads in the next 20 years, and in the field of passenger traffic will help to bring to the rails a good share of the business now hauled by other agencies."

That the designers and builders have not been standing still is indicated by the following quotation from the same report: "Few types of machinery have been so greatly improved in the past 20 years as steam locomotives. Weight per horsepower has been cut in half and

the thermal efficiency doubled. Progress in the future will undoubtedly continue. Higher boiler pressures, higher steam temperatures, greater fuel economy, greater steam capacity, better steam distribution, ability to make longer runs and greater mileage between shoppings—in all these and many other ways the steam locomotive is being so radically improved that comparatively few people realize the superiority of today's locomotive over engines built 15 or 20 years ago."

Yes, the steam locomotive promises to remain with us for a long time to come, and even where it is displaced we shall have to reckon with the elimination of obnoxious odors, gases and noise from the Diesel engines. A large hotel, not far distant, complains more about smoke and the oil film on its windows caused by Diesel engine exhausts than it did about smoke and dirt from steam switchers.

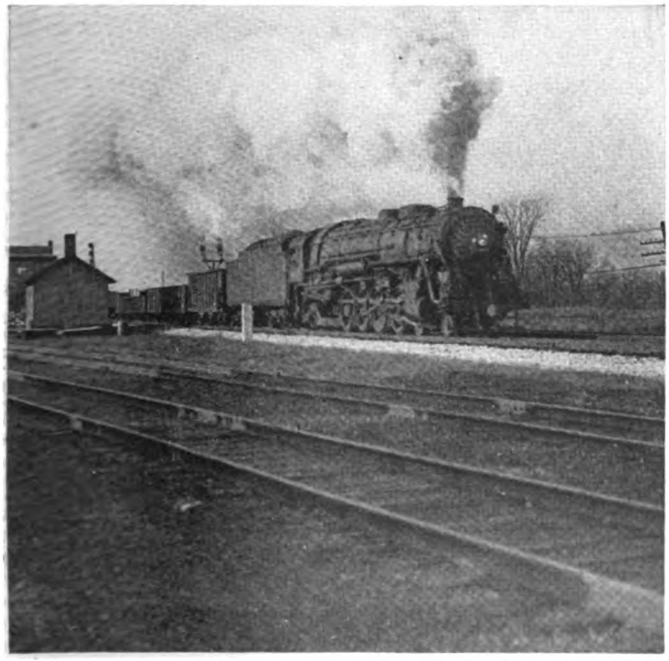
Why All the Argument?

But, you say, "Why all this argument? Is it not true that we have made excellent progress in smoke reduction in recent years? What is all the fuss and feathers about?"

My answer is this. Public appreciation of the finer things of life has advanced at an even more rapid rate. Take the item of dress, for instance. When I was a boy the styles in a midwestern city trailed behind those of the East by a year or more. Today, the farmer's daughter in remote sections of the country, wears the same styles as does the girl on Broadway in New York. Not so many years ago crackers were ladled out of a barrel at the grocery store and the loaf of bread was stark naked. Today, even ordinary crackers are handed to us over the counter in highly attractive and artistic, sealed packages, and the loaf of bread is attractively wrapped in cellophane and sliced, ready to serve.

Art in Industry

The expression "art in industry" is becoming quite commonplace. The Metropolitan Museum of Art of New York City maintains a director of industrial relations, who gives his time to making the museum collections of practical value to the manufacturer, the designer and the trade press. Many of our grade and high schools have courses in art appreciation and it is fascinating to see the rather high standard of taste of the average student, even in the very young groups.



"The bulk of freight will be hauled by steam locomotives"

Store window dressing and the display of goods on the shelves and counters is now in the hands of experts and has become more or less of an art. Tea rooms, gasoline service stations, hotels, restaurants, theatres, movie houses and stores vie with each other to provide artistic and comfortable surroundings and services. Incidentally, competitors of the railroads are not far behind in these respects.

Even the builders of machine tools and other machinery recognize the importance of artistic and well-shaped models; possibly the automobile, in the effort to develop sales appeal, has been a stimulant in this direction. At any rate, a machine with a shapely and artistic appearance gives the impression of efficient and effective operation, which is lacking in a design which presents a cruder appearance, even though it may be just as strong and efficient.

A few years ago I had occasion to visit the engineering school of Montana State College at Bozeman. At the end of a two-day visit in mid-winter, I went to the railroad station to take a train East. A few passengers huddled around the coal stove in the center of the room, waiting patiently for the train. Suddenly the door burst open and one of the engineering students rushed in. He handed me some information that I had requested the day before and apologized for the last-minute delivery by saying that he had been tied up during the day with one of his examinations—a course in art appreciation. I expressed surprise that a mechanical engineer was taking such a course, suggesting that in my day the cinch course for easy credits at the university was psychology, and that I presumed the course on art appreciation was in much the same category today.

"Not on your life," replied the student. "It is the hardest course I am carrying." Questioning developed the fact that the head of the Department of Mechanical Engineering was quite insistent that his students take this course, since he felt that it was of vital importance for a mechanical engineer to be so equipped.

Railroads Not Asleep

Quite rightly you can counter these statements and insist that the railroads have not been asleep. They, too, have employed artists and experts to assist in making more attractive the passenger equipment, even to the extent of de luxe furnishings in day coaches. Encouraged by the reception accorded the introduction of the high-speed, streamlined trains, and fearful of the continued inroads of other types of common carriers on the passenger traffic, they have done much to improve the comfort and convenience of their services. Incidentally, one of the most important results of the advent of air conditioning has been the exclusion of dirt from the interiors of passenger cars. These improvements have been greatly appreciated by the traveling public and are helping to bring business back to the rails. In spite of all this, however, it must be admitted that the railroads are still responsible for a considerable amount of unnecessary dirt and noise which irritates the general public on whose good will their welfare depends.

What Can Be Done?

What can be done about it? I have followed rather closely and critically an experiment which has been conducted in Hudson County, N. J., during the past six years. It was inspired by Stevens Institute of Technology at Hoboken. In 1930 Col. E. H. Whitlock was

called from Cleveland, Ohio, where he had served so acceptably for several years as commissioner of the Division of Smoke Inspection, to take the chair at Stevens of research professor of smoke abatement.

The authorities of Hudson County were approached to co-operate in this movement. A Department of Smoke Regulation was set up as a part of the Board of Health and Vital Statistics of that county, and William G. Christy, who had helped to organize the Citizens Smoke Abatement League of St. Louis, was appointed smoke abatement engineer in December, 1930.

Hudson County, on the banks of the Hudson River, opposite lower New York City, is the rail terminus of a number of railroads serving New York City; it is an important industrial center as well. As one of the first steps, the operating heads of these railroads were approached; smoke from the locomotives and the terminals was admittedly a serious problem. It was pointed out, however, that the density of the smoke was a measure of the inefficiency of the use of fuel and little difficulty was experienced in securing the interest of the railroad officers when it was indicated that it was intended to inaugurate a campaign of education, which would not necessarily involve any great amount of expense, and that this might be largely offset by the resulting savings in fuel.

Railroad Smoke Association Organized

The Railroad Smoke Association of Hudson County was organized early in 1931 and holds monthly meetings. Addresses are made by members or outsiders who are specially qualified, and reports are prepared and discussed by the members. The program of the Department of Smoke Regulation calls for about 850 observations of smoke from locomotive stacks per month, the density being based on the Ringelmann chart. During 1931, the first year of operation, 6,761 readings were made; since that time the number each year has exceeded 10,000.

Reports are regularly issued by the department, showing the results each month, the nine railroads being listed in the order of merit of their performances. During 1936 two of the roads averaged a smoke density of less than one per cent, a most excellent performance. The highest average for the road at the bottom of the list was 2.637, while the average of all the readings taken for all the roads was 1.657. This compared with 16.03 for the first year of operation of the department in 1931; with 5.20 for the second year, and with 3.45 for 1933, the third year.

In securing these results attention and study were given to all of the factors concerned with the efficient use of fuel. Naturally the human element was of first importance and steps were taken to insure careful checking and coaching of the engineman. You can readily understand how the study and discussion of this problem by the Railroad Smoke Association proved fruitful of results.

In some instances it developed that more attention had to be given to the proper kind of fuel to use and the supplying of uniform grades of fuel. It was also necessary in certain cases to give more attention to the condition of the power and to make detail changes in the locomotive design. These and many other related problems were developed in the meetings of the Railroad Smoke Association and with the cooperation of the Department of Smoke Regulation. Some idea of the interest in the activities of this association may be gained from the fact that the average attendance at its monthly meetings last year was about sixty.

Approaches to Cities

We are familiar with the activity of local chambers of commerce and service clubs in boosting and advertising the advantages of their communities. On the other hand, the approaches to most cities by railroad, at least, are through drab and dingy surroundings. The railroads are, of course, to a degree responsible because of the dirt and noise involved in the operation of passing trains. With cleaner and quieter operation and with the dressing up of their own properties, they are less to blame for this condition. With the practical elimination of smoke from locomotives and engine terminals—and this is possible, as has been proved in many cases—pressure can well be exerted on property owners along the right-of-way to do their part in making the approaches to the community more attractive. All of this will undoubtedly prove so much to the advantage of the railroads that they can well afford to assume the leadership by reducing the smoke and noise in train operation and in making their properties more attractive.

Returning to my original thesis. We are coming into a new day. The break will not be sharp; indeed, we have been traveling steadily in the direction for many

* * *

The New Haven "Comet" at Readville, Mass.

years. The artistic instincts of the public will be more and more offended unless locomotive smoke is practically eliminated. Unless we improve on our present practices we will surely be forced by legislation, or otherwise, to take steps that may prove extremely expensive, but which can readily be avoided if we courageously and persistently strive to minimize these evils as rapidly as possible, with the objective of eventually removing them entirely.

Smoke from locomotives is tangible evidence of wasteful operation. Your organization has always been a leader in the field of the efficient use of fuel and in smoke abatement. I beseech you not to relinquish your efforts in this direction.

Report on Fuel Records and Statistics

Trends in unit fuel consumption and various factors in train performance

During the year 1936 the locomotives of the Class I railways of the United States consumed fuel and power equivalent to a total of 97,732,494 tons of locomotive coal, at an average charge out price of $2.59 per ton, which involved a total cost of $252,821,000.00 and represented the expenditure for locomotive fuel and power of 6.2 cents out of every dollar of operating revenue earned.

These are very impressive quantities even in these billion dollar days. It is impossible to over stress the importance of the effect upon operating results that follows from the reductions in this heavy item of expense that are being made now and that have been made in comparison with the expenditures of past years.

Your committee therefore has felt that a brief presentation of the results gradually accomplished in this direction over the short period of the past ten years would be appropriate as a matter of interesting information and as a measure of stimulation toward still further gains in the future.

As compared with the year 1926, the Class I railways in 1936, by reducing the unit consumption of fuel in the three classes of service—passenger, freight and yard switching—saved fuel to the equivalent of 12,351,560 tons of coal with a total value of $31,990,540.00. This is equivalent to 12.6 per cent of the total expenditure for locomotive fuel for the year 1936; see Table I.

The freight service alone contributed 24 million dollars to this total through the 13 per cent reduction in the unit consumption of coal per 1,000 gross ton miles from 137 in 1926 to 119 in 1936.

Table I—Reduction in Unit Fuel Consumption

	1926	1936	Value of saving, 1936 vs. 1926
Passenger, lbs. per p.t.c.m.	15.8	15.3	$1,840,187
Freight, lb. per 1,000 g.t.m.	137.0	119.0	23,999,818
Yard switch, lb. per yard-engine hr.	822.0	706.0	6,150,535
Total			$31,990,540

It is our purpose in this report to emphasize:

First. The changes that have occured in the freight service performance of the larger individual Class I railways, in the ten year period just passed in comparison with the changes in the operating factors that are considered to be most closely involved with fuel performance, and

Second. To show graphically the year by year progress of the changes in the relationships between: (a) Fuel performance and engine load; (b) fuel performance and speed of movement; (c) fuel performance and gross ton miles per hour; as these changes in relationships are displayed by the annual averages for the Class I railways as a whole.

The 1936-1926 comparison of the factors that are significant in freight service fuel performance for 45 Class I roads, each of which made two billion or more net ton miles in the year 1936 is of interest. For this ten year period the percentage of change in unit fuel consumption for the 45 roads in the table ranges from a decrease of over 29 per cent to an increase of about 6 per cent with the average of the Class I railways showing a decrease of 13.15 per cent.

For these 45 roads the comparative change in this ten year period in average engine load, gross ton miles per locomotive mile, ranged from an increase of 68.4 per cent to a decrease of 21.1 per cent, with the average of the Class I railways showing an increase of 6.5 per cent. It is noticeable that in general, the largest percentages of increase in engine load are associated with the largest percentages of decrease in unit fuel consumption, and as indicated by the averages for the Class I railways as a whole, notwithstanding the 32.8 per cent increase in speed of movement, each increase of one per cent in engine load has been accompanied by a decrease of two per cent in the unit consumption of fuel.

The average weight of locomotive used, gross ton miles of locomotive and tender per locomotive mile, increased 17.5 per cent from 206 tons in 1926 to 242 tons in 1936.

The average speed of movement, train miles per train hour, increased 32.8 per cent from 11.9 m.p.h. in 1926 to 15.8 m.p.h. in 1936.

The average gross ton miles per hour increased 41 per cent in the ten year period.

Additional light is thrown upon this relationship between engine load and unit fuel consumption when further study is given the yearly averages of the Class I railways over a period; see Table II.

A contrast in value that is both interesting and instructive may be observed by setting up a comparison between the average for the first seven years and the second seven years of this fourteen year period. It may be observed that during the latter period a 5 per cent higher engine load was handled at a 27 per cent higher speed with a 13 per cent reduction in the unit fuel consumption.

Table II—Engine Load and Unit Fuel Consumption Class I Railways 1923 to 1936 Incl. Freight Service

	Pounds coal per 1000 g.t.m., incl. loco. & t.		Engine load, trailing		Speed, miles per hour		Gross ton-miles per hour	
Year	Fuel unit	Per cent increase vs. 1923	Tons	Per cent increase vs. 1923	M.p.h.	Per cent increase vs. 1923	Value	Per cent increase vs. 1923
1923	161	....	1360	....	10.9	....	16,764	...
1924	149	7.46	1417	4.19	11.5	5.50	18,261	8.9
1925	140	13.05	1485	9.20	11.8	8.25	19,685	17.4
1926	137	14.90	1540	13.20	11.9	9.15	20,705	23.5
1927	131	18.65	1577	15.95	12.3	12.85	21,940	30.8
1928	127	21.10	1624	19.40	12.9	18.35	23,652	41.0
1929	125	22.40	1650	21.30	13.2	21.10	24,539	46.3
1930	121	24.85	1665	22.42	13.8	26.60	25,843	54.1
1931	119	26.10	1625	19.45	14.8	35.80	26,721	59.4
1932	123	23.60	1525	12.12	15.5	42.20	26,064	55.5
1933	121	24.85	1570	15.45	15.7	44.00	27,344	63.1
1934	122	24.20	1585	16.55	15.9	45.80	28,041	67.3
1935	120	25.45	1604	17.95	16.0	46.80	28,674	71.0
1936	119	26.10	1640	20.60	15.8	45.00	29,186	74.2

According to calculation considered to be conservative, if other factors had remained unchanged, the increase in average speed would have resulted in an increase in unit fuel consumption of 15 per cent. It is evident therefore that other factors did not remain unchanged, but that measures not disclosed by the statistics were adopted that more than offset the increase in unit fuel consumption that was to have been expected and produced instead a decrease of almost equal proportion. The increase of 5 per cent in the average engine load undoubtedly had quite a favorable effect and it is probable that some of the measures adopted that were favorable to increased engine load and to improved fuel performance might be identified as the elimination of some proportion of expensive service and the more extensive use of heavier locomotives, some part of which were of modern design and improved construction.

When graphical representation is made of the data shown in Table 2, it appears to be definitely indicated that there is a consistently close correspondence between the increase in engine load and the decrease in unit fuel consumption. This correspondence is evident both upon the basis of the actual values year by year and upon the basis of the percentage of change in the values for each year from the values for 1923 considered as a base.

While undoubtedly many other factors enter into this relationship and affect it vitally there appears to be no doubt that increasing the average engine load, and the measures that have made it feasible, have been the dominant factors in the decreasing unit fuel consumption.

An abrupt break is noticeable in the conformity of the charted relationships in the year 1930, after which the comparisons appear to have become established upon a different plane from that which obtained up to January 1, 1929.

The increasing average speed of movement has had a disturbing and distorting influence upon the normal relationship between average engine load and unit fuel consumption, particularly so in the years since 1929, during which such large increments of speed have been added to the averages, while the engine load has decreased and the unit fuel consumption, after reaching the low of 119 lb. of coal per 1,000 gross ton miles for the year 1931, has fluctuated above that value for four years and only returned to it in 1936 with the decided increase in engine load obtained during that year.

A chart showing the relationship between unit fuel consumption and speed pictures the adverse influence of the increased average speed for the years since 1931. This increase in average speed has been accompanied by the decrease in average engine load, the combination which has exercised the strongest possible influence toward increased unit fuel consumption.

A chart showing the relationship between gross ton miles per hour and unit fuel consumption, displays also the effect of the disturbing influences that have obtained during the period of subnormal business volume.

In conclusion, it appears that the conditions surrounding the competition between lines for the business available and the high standard of service demanded by shippers and now firmly established by the railroads, indicate unmistakably that the higher average speed of movement is a condition that must be accepted as permanent. The fact that it penalizes fuel performance must be accepted and the only practicable offset is the utilization of a greater percentage of locomotives designed and constructed to move economically heavier trains at high speed.

The report was read by Chairman E. E. Ramey, B. & O.

Discussion

The general theme of the discussion following this report was to the effect that too few fuel records and statistics is likely to cost the railroads even more than the opposite extreme of too many fuel records and statistics. In other words, a happy medium should be chosen which will give railway managements sufficient information regarding fuel trends to know what is actually being accomplished and enable them to apply corrective measures promptly where necessary.

To illustrate what can be accomplished in the way of quick action, the experience of the Southern Pacific was cited, this road having recently established an extensive section of test track which is used for obtaining a rough check of locomotive fuel performance in passenger service. Locomotives of a given class and with a uniform train load are operated over this test track daily and sufficient clerical help has been employed to record the engineman's reports of fuel oil consumption between various points on the run. These fuel consumption figures are telegraphed ahead to the clerk who is able to detect immediately any locomotive which may be using too much fuel, due to worn cylinder packing, a leaky superheater unit or improper firing conditions. The operating department is notified and if necessary, the locomotive is taken out of service for repairs before the completion of the run.

Report on the Utilization of Coal

Suggestions for further reductions in the unit cost of fuel

(Detailed information included in this report regarding the proper inspection and preparation of coal is of great importance to the railroads, but may be considered the specialized interest of the relatively small group of fuel men responsible for these details. The present abstract of the committee's report will be devoted to the third section on Utilization of Coal.—Editor)

a—Have any studies been made by your company as to the cost of fuel per 1000 ton-miles, as distinguished, from unit performance in pounds per 1000 gross ton-miles?—ANSWER: Yes, for 12 of 13 replies. No, for 1 of 13 replies.

b—Do you consider the above study of practical value?—ANSWER: Yes, for 10 to 13 replies. No, for 2 of 13 replies. No, from a fuel conservation standpoint, for 1 of 13 replies.

c—Do you keep a record of terminal or roundhouse fuel consumption? If so, how is this done?—ANSWER: 9 state no record kept. 3 state periodical checks, occasional checks, or checks at various times are made. One states estimate made at time of each coaling by operator of coal pocket.

d—Have increased train speeds, long engine runs, and less standing time had any effect on the grade and preparation of coal required for locomotive use? What is the effect?—ANSWER: 5 state no change has been re-

quired. Of the remaining 8, each is quoted as follows:

"Yes. It has required coal of good quality and good preparation for use at important terminals on the high speed engines."

"Yes, we have to have a better grade for long, fast runs in order to cut out fire cleaning."

"On long engine runs, it is desirable to furnish a good grade of coal, in order to avoid long delays at intermediate terminals on account of fire cleaning."

"These changes have necessitated to some extent a better grade and preparation of fuel for fast passenger service. However, we have not found it necessary to change preparation or grade of coal to any extent on our freight locomotives with the increase in train speeds and long runs."

"The increasing demands on locomotive performance occasioned by increased train speeds, longer trains, shorter turns, etc., have intensified the necessity of using a good grade of coal and this has brought about the rejection of certain inferior grades of coal formerly purchased."

"Yes, exhaustive tests proved conclusively that a higher grade of coal with a lower ash content was necessary in order to prevent delays enroute cleaning fires, dumping ashpans, etc."

"Yes, requires coal of higher quality, lower in ash, and more uniform in size."

"Yes, this has necessitated using a much cleaner grade of coal."

How Reduce Unit Fuel Cost?

e—What can be done, in your opinion, to reduce the cost of fuel per car mile, or per 1000 gross ton miles?—Answer: All answers are quoted in order, as follows:

"Because of its ramifications this is not a question to be answered in a few words. A great deal depends on the expenditure necessary in the purchase of fuel, as a good fuel performance from the standpoint of the pounds consumed per unit of service would not necessarily mean a good cost per unit as that would depend largely on the price of the fuel."

"Maintenance—longer runs—determine and use proper size and grade of coal—efficient engine operation."

"Keep the power in first class condition at all times and supervision enough to see that the best practice in handling and firing the engine prevails at all times, including train and yard movements."

"Furnish the particular fuel which has proved most economical and suitable for use in the various classes of service. Study all factors that affect the full consumption rate, with a view of eliminating inefficiencies as far as possible.

"In all production activities the volume of production vitally affects the unit cost of production and the production of transportation by the railroads is no different in this respect from other production activities. Increasing volume of business tends automatically to reduce all railroad operating unit costs, including unit fuel costs and the present trend of business volume is favorable to that end. In opposition to this favorable factor are the rising costs of all the detail elements that combine to establish the gross operating expense of the railroads. These can be offset only by gradual improvement in the physical plant including the rolling equipment and the permanent way and the facilities provided for their maintenance, supplemented by improved operating methods through which the most effectiveness of the plant may be realized. Among the necessary improvements prominent position must be assigned to the gradual replacement of obsolete power with locomotives of modern design, adapted to the existing conditions of operation and those to be immediately anticipated. Reduction in the unit cost of fuel along with reduction in the other unit costs, will be influenced to a greater extent by these necessary fundamental improvements than by any secondary supplemental measures that are practicable.

Systematic Supervision over Details Is Essential

"However, this fact does not by any means detract from the value of systematic supervision over the details that affect economical use of the fuel under a given operating set-up. It is considered that the principal features in the order of their importance are about as follows:

"1—A high standard of maintenance of the operative condition of the locomotive.

"2—Instruction and supervision of the enginemen and firemen.

"3—Instruction and supervision of the engine terminal employes.

"4—Systematic distribution of fuel to coaling stations and adequate inspection service to maintain standards of quality and grade of fuel.

"5—Adequate, accurate and promptly available sta-

* * *

tistical records of performance for the information of all concerned."

"By carefully watching the fuel consumption on the different types of power with the class of service such power is used. Study the length of time that a locomotive should be held under steam at terminals to determine the economical period in which fires should be dumped."

"We believe that is still an opportunity to reduce full costs by the following methods:

"Keep locomotives in good serviceable condition.

"Supervision of the handling by both the engineer and fireman essential.

"Reduce cost of fuel for firing up, allowing only time enough to get the engine ready after the call. Direct steaming of engines will make a big improvement where possible to obtain this facility.

"Should insist on best preparation of the coal. There are also many other factors that need consistent supervision, with the detail of which you are familiar. We have made a study in yards of how many hours a yard engine should be working in order to get best results. We find that 16 hrs. out of 24 hrs. should be worked either straight through or staggered. Say, 8 hrs. from 8 a. m. to 4 p. m. then back into service at 12 midnight to 8 a. m. This will cut fuel costs in yard service."

"Continued education of terminal forces to fire up locomotives on shortest time possible to fill orders on time for the yard.

"Make frequent tests to insure proper cleaning of flues, maintaining feed-water heaters and leaks in front ends, grates, brick arches as well as maintaining valve gears and other parts of locomotives in best serviceable condition.

"Co-operation from the transportation department to reduce the time of locomotives laying in the yards waiting for the trains to a minimum, also prompt movement of the locomotives to the engine terminals after completion of trip.

"Proper education of terminal forces on fire cleaning, firing up and banking of fires on locomotives not dumped, overloading of tanks, proper use of blowers, and the practice of having air pumps, generators, etc., shut off when the locomotive is at rest."

"The cost of fuel per unit of volume can be reduced by:

"a—Use of proved appliances which improve boiler performance and efficiency.

"b—Instruction and supervision of engine and terminal forces as to efficient and economical use of fuel.

"c—Replacement of obsolete and uneconomical locomotives with modern equipment.

"d—Insistence upon the use of a good grade of coal."

"Continued supervision of all factors pertaining to fuel waste as outlined by previous proceedings of the International Railway Fuel Association.

"Experience would indicate that when selecting a locomotive coal, inspection and analysis should not be entirely depended on, but in addition the coal in question should be actually tried out on the locomotive to determine whether or not it meets the requirements of the individual railroad.

"Railroads that are located great distances from the coal mining regions where freight rates per ton amount to considerably more than the cost per ton at the mines, must necessarily be very careful in selecting the grade of coal that is not only suitable for the service demands, but is suitable from the unit cost standpoint."

"Keeping locomotives in good serviceable condition, adequate and careful supervision in work of fuel economy in all its phases, of which all of us are familiar including a check of train operations, consist, speed, etc."

"Maintain interest in the work of fuel economy."

"More rigid inspection, careful attention to distribution, more rigid specifications. Education of officials and employes along fuel economy lines. Supervision of crews. Extension of locomotive runs wherever facilities are suitable or can be made so."

"Using as far as practicable and economical, smaller sizes and lower-priced coal on stoker-fired locomotives, without lessening efforts to keep consumption at a minimum by stimulating interest in fuel conservation, longer engine runs, reduced time and fuel consumption at terminals, a high standard of maintenance, modernizing power, and reducing train delays to a minimum."

The report was signed by Chairman W. R. Sugg, supt., fuel conservation, M. P.

Valve Motion and Its Effect on Fuel Economy

Report advocates more mechanical training for firemen to insure intelligent work reports

Last year your committee in presenting its paper on this subject called to the attention of this association several pertinent reasons for paying closer attention to valve motion. It was not the intention, however, to recommend a standard setting for either passenger or freight locomotives, but rather to urge a standard of maintenance when once the setting was decided upon that would insure better locomotive performance at lower maintenance cost.

It was also pointed out last year that many young men would soon be employed to fill the present dwindling ranks of veterans. This transition is now taking place, and we feel that now is the time to begin the education of the rising generation of both operating and maintenance forces.

We believe that now is the time to insist candidates for employment and promotion be educated to a degree that study of mechanics and locomotive operation will not be irksome, and the information laid down in mechanical books pertaining to the care of the locomotive boiler and engine can be readily understood by everyone.

Marine engineers serve an apprenticeship while firing, they must acquire a thorough knowledge of the construction and operation of all the machinery under their charge, and finally are required to pass an examination before a marine board to prove their fitness for the position. Why should locomotive firemen not be required to pass a somewhat similar examination?

Were this the case, then the care of valve motion would receive closer attention, as those reporting defects would be better equipped properly to report the trouble, thus saving many hours of needless work at considerable expense by mechanics at repair points. Then if the defects are due to improper steam distribution, a standard system of correction should be followed at all repair points on the system. This is not now the case on many railroads.

A thorough understanding of valve motion by the locomotive operator and maintenance force will tend to promote a better appreciation of economies that affect the

cost of locomotive operation, such as the elimination of an extra stop for water or coal, or that more tons of freight may be moved at higher speed, without increasing the fuel consumption.

Properly maintained valve motion also tends to reduce rod and driving box maintenance, and makes a smoother running engine.

It is also expected a better understanding of valve motion will promote more economical engine running, especially on railroads that have no mechanical means of showing individual locomotive performance.

The price of fuel is steadily advancing, as is the cost of labor and machinery, in fact, all railroad supplies are steadily advancing, while the cost of the commodity sold by them (transportation) seems to be stationary or retreating, therefore, it behooves closer attention by mechanical men to the heart of the locomotive, which, like the heart of man, is the most delicate and most important part of the machine, and also probably the least understood, and when out of tune is the most costly to both man and machine. A better understanding of which will not only prolong life, but pay handsome dividends through fuel savings and lowered maintenance costs. The report was signed by Chairman M. F. Brown, N. P.

Discussion

At the conclusion of Mr. Brown's report, the problem of how to keep valve motion square was briefly discussed. One speaker told of the trouble his road had with a series of locomotives because the reverse gear was not heavy enough to prevent the valve gear from creeping. The reverse gear was redesigned to eliminate this trouble. Since valve motion is the controlling factor in proper steam distribution, it was recommended that more indicator cards should be taken to check valve-motion performance.

Front Ends, Grates and Ashpans

Review of Mechanical Division report and descriptions of new front ends

Your Committee on Front Ends, Grates and Ashpans submits its report in three parts as follows:

On December 27, 1935, the Mechanical Advisory Committee, consisting of Messrs. L. K. Sillcox, F. W. Hankins, F. H. Hardin, John Purcell, C. J. Bodemer and W. J. Patterson, submitted to Joseph B. Eastman, then federal coordinator of transportation a report, consisting of a 700-page volume, which covered a wide range of subjects connected with railway rolling-stock and related matters. From the first section of this report, discussing the steam locomotive, we have copied verbatim those paragraphs representing the considered opinion of this distinguished advisory committee on those matters with which your committee is concerned. We have done this as a means of placing before a large group of railway men, directly concerned with the topics discussed, this material which might not otherwise be available to them.

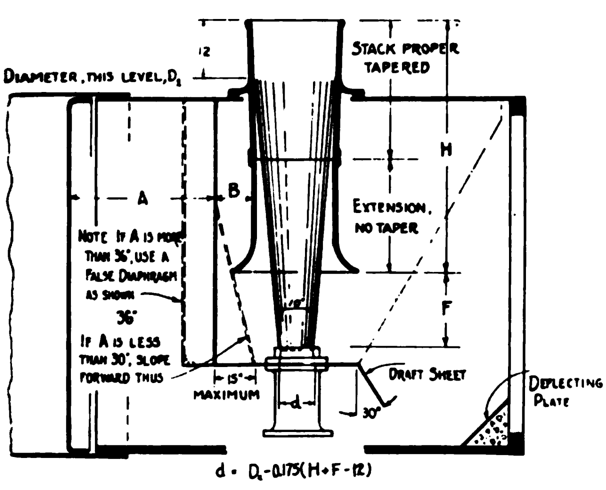


Fig. 1—Suggested diaphragm arrangements with Master Mechanics' front end

At the meeting in Chicago in June, 1936, the Committee on Locomotive Construction of the Mechanical Division of the A.A.R. presented, as part of its report, the report of a Subcommittee on Front-End Arrangements. We have made a very brief digest of this latter report, which virtually establishes a new Master Mechanics' front end, in order that we may make certain comments and criticisms on the proposals, and that this convention may have a similar opportunity to comment upon and to discuss this report.

We have made brief notes on such new or recently modified appliances within the field of this committee as have come to our attention since the last report was made. These are two in number only: the Coffin Superdraft arrangement, and the modifications which have been made in the Cyclone spark arrester.

Paragraphs from the Report of the Mechanical Advisory Committee

The following paragraphs of this section are verbatim quotation from the Advisory Committee's report.

Stack Proportions—It is reasonable to assume that the relative areas of smokestack and steam jet have an important bearing on the degree of efficiency since, for equal displacements, a small smokestack must necessarily entail a higher velocity of the gases than a large one. The efficiency, when measured in back pressure horsepower as compared with the weight of gas discharged therefore, will be lower under the former than the latter conditions. Also, since, by reason of its loss of pressure after leaving the nozzle, the jet of steam is expanding, the cross-sectional area of the stack should be increased upward, thereby avoiding a restriction in the area of the flow. The gases may contract during contact, and partially mingle with the cooler steam, but, on the other hand, this will increase the expansion of the steam, and every facility should be provided for allowing the steam to freely expand, thus converting its static into kinetic energy while it is still in contact with the gases in the smokestack. Likewise, the cross-sectional area must be enlarged to the point where the gases will not normally fill the stack.

Front-End Designs—Since one function of the front-end arrangement is that of intercepting cinders, delaying their passage through the stack until all fire is extinguished and they are relatively cool, some resistance must, of necessity, be introduced into the smokebox,

whether in the form of netting, through which all exhaust gases must pass or in the form of a longer path. The Master Mechanics' front end was used almost exclusively for many years and was considered entirely satisfactory, such difficulties as were experienced and losses suffered being accepted as unavoidable in view of the functions to be satisfied. The front-end problem has been attacked with renewed vigor in recent years, and the Master Mechanics' arrangement of netting and baffles is giving way to several improved designs which offer more in spark protection, accessibility, simplicity, reduced maintenance, or lower resistance to the passage of the products of combustion.

Digest of the Mechanical Division Report

The conclusions and recommendations of this subcommittee are summarized in the nine paragraphs which follow:

Gas Areas—The successive areas through which the gases pass should be proportioned as follows. If 100 per cent represent the net gas area through the tubes and flues, the corresponding areas of other gas passages should be approximately 115 per cent over arch, 95 per cent gross area under table plate, 85 per cent minimum net area under table plate, deducting nozzle stand, etc.; 75 per cent under draft sheet, 130 per cent net area through netting and 25 per cent minimum area of stack.

Stack—The minimum diameter of the stack should be the value in even inches corresponding to the area nearest 25 per cent of the net area through tubes and flues. The stack proper should have a taper ranging from 1 in 12 to 1 in 15 and should be 30 in. high if possible. The extension should be straight, with a wide flare, and should extend down to 15 or 16 in. above the top of the nozzle.

Exhaust Stand—The exhaust stand should be rectangular in section and should have a dividing wall extending up 8 or 9 in. to prevent blow-over.

Blower—The ring-type blower is the most economical.

Draft Sheet—The draft sheet should normally be inclined 30 deg. from the vertical; it should fit up neatly against the sides of the smokebox with its front edge exactly horizontal.

Deflecting Plate—The use of a deflecting plate at the front of the smokebox at the bottom is advisable, both to protect the front of the boiler and to prevent the accumulation of cinders in the corner.

Nozzle—The diameter of the nozzle should be determined from that of the stack on the assumption that the steam jet spreads at an angle of 10 deg. (5 deg. each side of the vertical axis) and that the jet come into contact with the stack wall at least one foot below the top of the stack. Thus, if dimensions are designated as in Fig. 1, the tangent of the 5-deg. angle being 0.0875, the diameter of the nozzle *d* is given by the formula:

$$d = D_1 - 0.175\ (H + F - 12)$$

The use of a cross spreader for the steam jet is recommended.

Diaphragm—If the space between the tube sheet and the diaphragm is greater than 36 in. a false diaphragm should be installed behind the regular diaphragm to reduce the volume; the space between the two diaphragms should be air-tight. If the space between tube-sheet and diaphragm is less than 30 in., the lower portion of the diaphragm should be sloped forward and should meet the table plate as near the exhaust stand as possible, except that the bottom of the diaphragm should not be more than 15 in. ahead of the top. If *B* is excessive, a false diaphragm may also be an advantage on similar engines. See Fig. 1.

Obstructions in Gas Passages—All pipes and other obstructions in the gas passage under the table plate should be gotten rid of if possible, even to the extent of redesign of the main steam pipes, and placing auxiliary outside of the front end.

Comment on the Report

Your committee believes that some of the terms used in the report vary from those which have been generally used and consequently presents Fig. 1, which

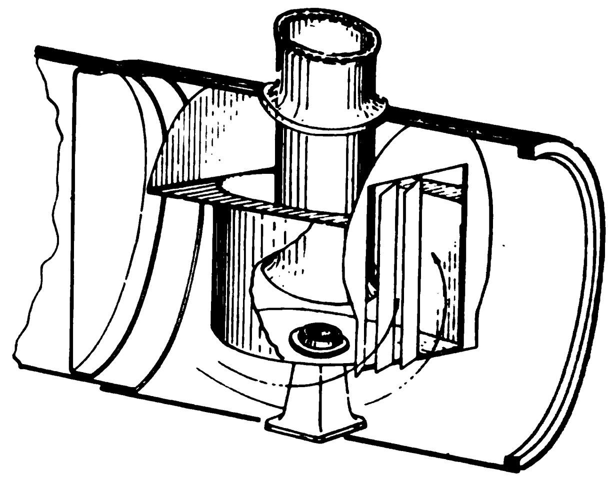


Fig. 2—Type-B Cyclone front-end arrangement

gives names of parts as used in the report where there can be any doubt as to their meaning. This figure also indicates the suggested diaphragm arrangements and the geometry of the exhaust nozzle design.

With respect to paragraphs on the exhaust stand, the blower, deflecting plate, and obstructions in the gas passages, your committee is in full accord. As regards the removal of obstructions from the gas passages, we believe this to be much more important than is generally realized.

With respect to gas areas, the Front-End Committee sets up a logical basis for design, except that the relation between the stack area and that of the tubes is rather indefinite. The report permits a variation in stack area of from 23 to 27 per cent of the fire area through the tubes; this would represent as much as 2 in. difference in stack diameter for some values of gas area.

With respect to the stack form, we offer no criticism but call attention to the fact that the influence of the form of the flare is debatable. The Pennsylvania front-end tests as reported in their Bulletin No. 9 many years ago demonstrated that the slightly diverging flare was extremely effective. The distance F should approximate the stack diameter, rather than be fixed at 15 or 16 in.

With regard to the draft sheet, the inclination of 45 deg. from the vertical and a slight lengthening of the sheet would result in an equal gas velocity and at the same time reduce the turbulence of flow around the lower edge of the sheet. There is enough eddy effect about the lower edge of this sheet, even under the best conditions, to produce an effect which substantially reduces the effective area of flow.

The paragraph on the nozzle is open to serious objection. The steam jet does not follow the course indicated by the proposed method of design; for its form is affected as soon as it comes into contact with the gas, and even more after it enters the range of influence of the stack. There is in the report no indication as to whether the use of the spreader requires a change in nozzle diameter. The proposed method of design results in a variation in diameter which is definitely con-

trary to known results; the greater the distance from the top of the stack to the top of the nozzle ($F + H$), the smaller becomes the diameter; this is exactly the reverse of actual requirements.

As regards diaphragms, a suggestion for the use of the false diaphragm, assumes that the reduction of front-end volume is advantageous. We know of no proof that reduction of front-end volume is effective in improving draft action. The beneficial effects of the forward-sloping diaphragm are apparent; there will be still further improvement if the obstruction to flow represented by the sharp corner connection between diaphragm and table plate is rounded off.

Modified Devices

The Cyclone Front End—The Cyclone style front end, which has been previously considered in some detail in the reports of this committee, is a widely-used substitute for the Master Mechanics' front end. A design is now offered by the builders of this device so arranged that the top plate of the structure is eliminated, and the chamber in which the whirling gas motion is set up extends clear to the top of the smokebox. This eliminates the difficulty of fitting the top plate around the bottom of the stack. This new form is represented in Fig. 2.

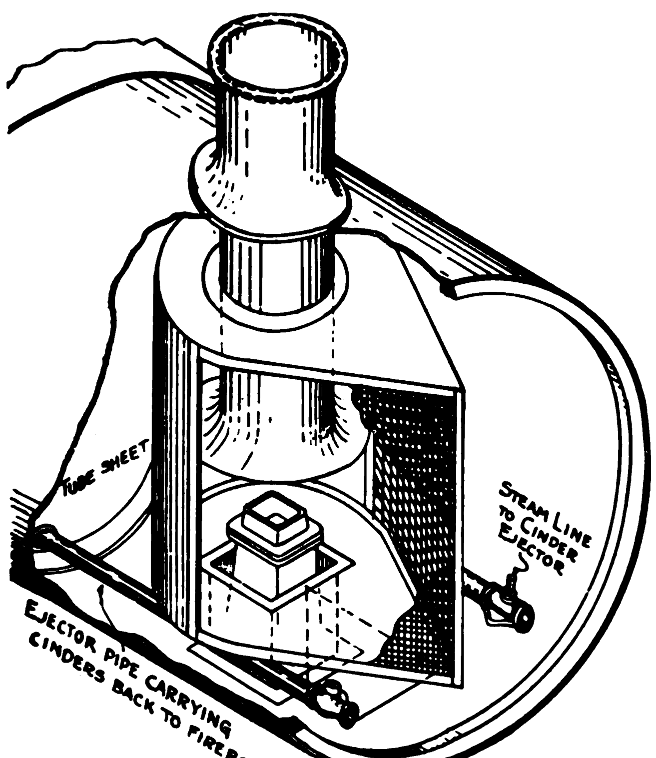


Fig. 3—Coffin Super-Draft front-end arrangement

The Coffin Superdraft Arrangement—This device which has been on the market for several years, but which has not been previously noted in the reports of this committee, consists of a special separator in the front end, and a means of ejecting cinders collected in the front end and returning them to the fire. It is represented in Fig. 3. The usual plates and baffles in the front end are replaced by the separator, which consists of a half-cylinder of solid plate turned backward toward the tube sheet, its axis being the same as that of the stack, and a wedge-shaped extension forward of the stack made of perforated plate. The separator structure extends from a point just below the nozzle to some distance above the stack flare. A small portion of the cinders traversing the tubes passes out through the perforated plate in the wedge, but most of the cinders drop to the bottom where they are picked up by the ejector arrangement. The ejector pipe passes through the throat sheets and returns the cinders to the fire through a specially formed opening in the arch brick. Either feature of this device seems well worth consideration. Installations have been relatively few and operating reports somewhat contradictory.

In conclusion the committee wishes to express its obligation to Professor E. G. Young who, before our meeting on May 17, organized material for our consideration, and afterwards prepared this report.

The report was read by Chairman E. C. Schmidt, Professor of Mechanical Engineering, University of Illinois; J. Traylor and E. G. Young.

Discussion

It was the consensus of opinion that front ends requiring netting should not and would not be used on future locomotives. A few of the reasons given were that the Master Mechanics' front end did not properly control hot cinders going out of the stack and that, with the large firebox of modern power, the fire burns out in the middle leaving incomplete combustion along the sides. The Thompson front end was briefly described. Results obtained so far indicate more even combustion in the firebox, better control of hot cinders, lower back pressure and lower maintenance costs.

The question of slag formation on tube sheets was discussed at length. Many reasons were given as to the cause of this trouble, including poor coal, high firebox temperature, excessive draft and leaks around the flues.

Improved and New Locomotive Economy Devices

Developments in feedwater heaters, circulation devices, superheaters and valves

In the past few years due to the business depression your committee has had very little to report to the association in the way of new devices promoting fuel economy. This year we have a few new devices which we can call to the attention of the members, as well as a number of improvements in existing devices.

Before proceeding with the descriptions of new heaters or improvements, we might indicate the extent to which feed water heaters have been applied to locomotives by bringing up to date a table given in the 1931 report of this committee. See Table I.

The manufacturers of feed water heating equipment have shown considerable activity. The Consolidated Ashcroft Hancock Company has brought out a new heater called the Hancock turbo-injector which is briefly described below.

Hancock Turbo-Injector—This heater is of the open type in as much as the feed water and exhaust steam

are actually mixed. The heater consists essentially of a four stage, turbine-driven-centrifugal pump, and a condensing chamber together with a control valve, an automatic heating valve, and an operating valve. Water from the tank is taken into the first stage of the pump which serves as the cold water pump of the usual open heater and raises the pressure to about 70 lb. per sq. in. This stage discharges into the condensing chamber which is composed of a number of nozzles and combining tubes. Exhaust steam is taken from the exhaust cavity of the cylinders and passes through the control valve to the condensing chamber. Here the cold water is discharged through the nozzle into the combining tubes entraining, exhaust steam thus heating the water. The hot water is taken from the condensing chamber by the second stage of the pump. The 2nd, 3rd, and 4th stages of this pump are the feed-pump portion in which the pressure is raised sufficiently to overcome the boiler pressure and pass into the boiler.

Status of Feedwater Heaters on Locomotives

Year	Pump type	Injector type
1920	7	....
1921	54	....
1922	234	....
1923	1429	....
1924	2123	24
1925	2551	37
1926	3527	362
1927	4918	519
1928	5586	593
1929	6729	838
1931	8755	900
1937*	9728	1170

* Applied or on order as of July 1st, 1937.

The pump is controlled by the operating valve which is ordinarily in the cab. This consists of a pump throttle for starting and stopping the pump and a water regulating valve which regulates the flow. An automatic heating valve is provided to prevent entry of cold water into the boiler during periods when no exhaust steam is available as when drifting or standing. This automatically supplies live steam to the control valve during such periods. To maintain proper balance of conditions a by-pass valve is provided in the suction line to the second stage of the pump which allows excess of hot water to flow into the tank. This hot water is discharged into the tank close to the suction of the first stage and hence does not unduly raise the temperature of the water in the main cistern.

This heater is claimed to heat the feed water to within 15 deg. of saturated steam temperature corresponding to the back pressure. When no exhaust steam is available, the water entering the boiler is heated to about 200 deg. F. by means of live steam as previously described. The weight of the component parts of the heater is 1300 lb., of which about 800 lb. is in the pumping unit.

Elesco Coil Type Heater—The Superheater Company several years ago brought out a modification of their closed-type heater in which coils of 1 in. copper tubing are used instead of straight tubes. Each coil is capable of heating about 2000 gallons of water per hr. and a sufficient number of coils are provided to suit the requirements of the boiler in question. The coils are mounted in a suitable receiver and are connected independently in parallel circuits. As usual the water passes through the tubes which are surrounded by the exhaust steam. It is claimed that this type of heater has higher heat transfer efficiency and because of higher water velocity and more turbulent flow shows less tendency to scale accumulation. The construction is simplified, the weight is reduced and the installation cost is somewhat less than their conventional closed type of heater.

Exhaust Steam Injector—The Superheater Company announces improvement in the exhaust steam injector by the incorporation of an exhaust pressure regulator which adjusts the exhaust steam to exactly the amount which the injector can handle irrespective of exhaust pressure, water temperature in the tank or quantity of water being fed to the boiler. This, it is said, very materially increases the efficiency and stability of the exhaust steam injector and permits it to handle feed water as hot as 150 deg. F.

Coffin Heater—The J. S. Coffin Jr. Company report improvement in their feed water heating system by the development of a new auxiliary heater placed in the forward corner of the water tank. Here the condensate from the closed portion of the heater is reclaimed and mixed with the cold water going to the pump suction. The auxiliary heater is equipped with a suction strainer and also a filter. Separation of oil from the feed water and some de-aeration is accomplished in the auxiliary heater.

Coffin Tank Type Heater—We do not believe that the Coffin open-type heater has ever been mentioned in these proceedings. This heater is of the open, storage type, being located in the left forward corner of the tender. In common with other heaters of this type it is necessary to control the temperature to which the water is heated to avoid difficulties with water flashing into steam when heated too hot. This heater employs the Standard Coffin pump and control system used in connection with their closed heater system mentioned above.

Superheaters—The Superheater Company has made an improvement in the Type-E Superheater units which results in reduced maintenance costs and at the same time provides for better gas flow with resultant improvement in the steam distribution through the units. The new units are interchangeable with the old units both individually and in sets.

Fire-Box Devices—Several new devices have appeared which have for their purpose the increasing of fire box heating surface and the improvement of circulation in the fire box.

Fire-Box Circulator—The American Arch Company

* * *

Lackawanna Limited, Westbound, New Milford, Pa.

has devised a fire box circulator which provides a tube connection between the side sheets and the crown sheet. This is in the shape of an inverted *Y* with the stem of the *Y* connected to the crown sheet at or about the center line of the boiler, with the legs connected to the side sheet. These circulators serve as a support for the arch.

Downflow Syphon—This is a modification of the well-known Nicholson syphon and differs in that the usual connection to the throat sheet has been eliminated and instead a leg is extended through a sleeve inserted in the bottom combustion chamber and shell sheets. The upper portion of the syphon has also been arranged so that it is fastened to both the crown sheet and door sheet of the fire box. To date we have heard of no applications of this device to locomotives.

Nicholson—Duplex Syphon—The Locomotive Firebox Company has brought out a modification of the Nicholson Thermic syphon which is called the Duplex syphon. In this arrangement the syphon is equipped with two necks, one of which is connected to the throat sheet as before, and the other to either the side sheet or bottom combustion chamber sheet. Thus in installation with three syphons in the fire box the center syphon has one neck connected to the throat sheet and the second to the bottom of the combustion chamber. The two side syphons have one neck connected to the throat sheet and the other to the side sheet of the fire box.

Locomotive Valves—With higher speeds of both freight and passenger trains we may have to revise some of our ideas on the valve setting of the locomotives. This applies not only to new engines with higher boiler pressures, but also on existing engines originally designed for lower maximum speeds. We have no constructive suggestions to offer at this time but merely mention it as a point to be considered.

In this connection, the Franklin Railway Supply Company is reviving interest in poppet valves for steam locomotives. The design is still in the development stage, no applications having been made to our knowledge. Those of us who were at the recent A.A.R. meeting had an opportunity to inspect a model of this new development.

In concluding this report we might call attention to the need for fuel economy devices which are not on the locomotive itself.

It is quite obvious in passenger service that the fuel burned on the locomotive is not all chargeable to the locomotive itself. With increased electrical load due to better lighting and air conditioning, and with increased steam demands on some railroads due to steam system of air conditioning, we find the fuel used by the train itself steadily increasing. While it might seem rather far fetched to call an improved axle generator drive, or more efficient car, or pipe insulation locomotive fuel economy devices, they never the less do fall into this category.

While we cannot direct the attention of the association to any specific devices of this kind we can say that insulation of cars is receiving considerable attention, undoubtedly due to the wide spread application of air conditioning. This includes better sealing of windows and doors to stop leakage from these sources and better sound deadening which ordinarily carries with it better heat insulation. Axle drives have received considerable attention in the past few years with the introduction of more positive types of drives eliminating to a large extent the power lost in slipping belts on the older types.

Insulation of the steam lines, particularly the insulation of the metallic connectors between cars, is still a problem. While certain portions of these connectors can be readily insulated, other portions particularly the ball joints themselves and the coupler heads, cannot very well be covered. It is, furthermore, rather difficult to maintain the insulation on these joints because of their location, being very much exposed to flying stones and the like. The new tight-lock coupler aggravates this condition somewhat in as much as it increases the length of the flexible connections very materially.

The report was read by Chairman A. G. Hoppe, assistant mechanical engineer, C. M., St. P. & P.

Discussion

The discussion following Mr. Hoppe's paper developed the fact that the performance of a locomotive device is always expressed in terms of gross economy instead of net economy. To determine net economy consideration should be given to maintenance costs and constant performance.

The question of how to determine accurately the amount of fuel required to cool and heat a passenger train was discussed at length. A representative of the Engineering Research Division of the A.A.R. briefly referred to a report covering the performance of all types of air-conditioning equipment which contains much data on the consumption and cost of the fuel required for cooling one or more cars. The same basic data can be used to determine the fuel cost for heating a train. A copy of the report will be sent to anyone writing to L. W. Wallace, director, Engineering Research Division, A.A.R., Chicago.

A suggestion was made that a study should be made of the AB freight brake as a means of obtaining further fuel economy. Because of increased train speeds, the air-brake equipment must be properly maintained and operated or else fuel costs rise.

Locomotive Firing Practice—Oil

With the general increase in railway business it has again become necessary to take into the service many new men. It has been so long since we have had to train new men in engine service that the organization for such training may have been forgotten. All will agree that the new fireman is entitled to thorough instruction, counsel and support from not only his fellow enginemen, but from supervisors who are detailed to handle such work.

With an oil-burning locomotive, where there is no material quantity of fuel in the firebox and where, if the locomotive is efficiently drafted, there is only a reasonable amount of excess steaming capacity, it is of the first importance that the fireman so handle his part of the work that when leaving the initial terminal full pressure will be maintained without smoking the locomotive. The adding of a large volume of cold water to the boiler with the injector just before leaving initial terminal is ruinous to this condition. A large volume of water added in this manner will stay near the bottom of the boiler until rapid circulation is started by applying a load to the boiler. The mixing of the cool water from the bottom of boiler with the hot water at the surface naturally reduces the rate of steam generation. The brickwork and firebox are still comparatively cold. Under these conditions it is difficult for the fireman to maintain a full head of steam while pulling out of the yard. Again, if the start is made with the boiler full of water it is

almost sure that sufficient water will pass over through superheater units and cylinders to remove at least the majority of lubrication from the valves and cylinders.

After leaving the initial station and it is possible to sand the engine without objection from adjacent property owners, the flues should be thoroughly sanded. Thereafter best results are obtained by adding three to five scoops of sand quite frequently rather than adding a large amount of sand at less frequent intervals. The amount of sanding is naturally dependent upon the general steaming condition of the locomotive.

A good fireman will split notches on the firing valve quadrant so as to maintain the maximum pressure without popping. Large adjustments on the firing valve produce extreme variations in pressure. These large variations also make it necessary to force the fire to regain pressure previously lost.

Nearly all oil-burning railroads today are using heavy cracked fuel, either straight or blended, but even so, it is not possible to give definite detailed recommendations as to the heating of fuel oil because of the wide variation in character of fuel.

The Responsibility of Enginehouse Forces

It should be the responsibility of enginehouse forces so to prepare the locomotive that when the fireman reports for duty the fuel oil is at a reasonable firing temperature. From that time on the entire responsibility rests with the fireman. If best economy is to be obtained, the fuel should be maintained at a temperature within a range as specified by supervisors or higher authority. There is a temperature for each fuel oil that will give the most efficient results in service. That temperature should be maintained as closely as possible. Fuel-oil thermometers are as valuable as any pressure gage in assisting fireman to burn fuel efficiently.

When the fuel line appears to be obstructed and the blow-back is used to clear the line, it is recommended that the first blowing be through the burner to firebox with tank valve closed. Then close the burner and blow to the tank. The purpose of this is to free the blow-back line of all water before blowing in to the fuel tank. A shot of water in hot cracked or blended fuel may cause the fuel tank to boil over. When relighting the fire always have burning waste or a lighter torch in the firebox before turning on the fuel. Without a flame in the firebox there is serious danger of a backfire when opening the firing valve, due to the hot brickwork gasifying the fuel until there is an explosive mixture.

After a long run and the firebrick and firebox are very hot, either a fair fire should be maintained for a few minutes, even though the safety valves open, or the fireman should close the dampers to prevent cold air from chilling the firebox.

Firemen should note the condition of brickwork at some intermediate stop. If the temperature is uniform throughout the firebox, the brickwork will have the same general appearance throughout the box. Air leaks in fire pans can always be detected by the breaking down of brickwork where exposed to air leaks. Burners out of line can easily be observed by action of the fire. A shortage of air on one side or excess fuel on that side can frequently be observed by noting the stack condition, that is, colored on one side and clear on the other. A grey appearance of firebox sheets indicates uniform temperature conditions. A variation in color, such as black soot in certain spots, lower temperature of firebrick on one side or the other, or carbon accumulations, all point to unequal fire or temperature distribution. These observations should be reported at the end of trip, thereby assisting the enginehouse forces in their effort to maintain your locomotive in good condition. Any erratic details in water-pump operation, injector, firing valve or other appurtenances should be reported. Team work of this character will make work easier for everybody as well as pay big dividends in the saving of fuel.

The report was presented by Chairman R. S. Twogood, S. P.

Discussion

The discussion following the presentation of this committee report was quite extensive and profitable to the large number of persons interested in oil firing practice. Much of it pertained to the methods of heating the oil now generally being burned, which is so heavy as to constitute a real problem in handling both in wayside storage tanks and on the locomotive tender. It was generally agreed that both direct and indirect heaters are required, the latter being necessary primarily for stirring up the oil but used for short periods, only, so as to avoid introducing any more water into the oil than absolutely necessary.

In general, to secure efficient combustion on oil-fired locomotives it was said that air should be mixed with the oil and raised to the firing temperature as early as possible in its passage through the atomizer. Oil should be carried in the tender at from 100 to 200 deg. F., dependent upon conditions, and the statement was made that the use of a thermometer to enable a fireman to maintain this temperature accurately at a predetermined point is a good investment.

Locomotive Firing Practice—Coal

It is the thought of the sub-committee on coal-firing practice to confine their brief remarks strictly to firing practices between terminals, leaving questions for open discussion, due to many systems of firing now in use.

Firemen should arrive at the locomotive on the ready track in ample time to check the firing tool equipment, prepare his fire to suit the requirements of the run to be covered and type of locomotive used, using blower lightly and supplying coal in same proportion to minimize emission of smoke and control boiler pressure so that safety valves will not open.

No hard and fast rule can be made covering depth of fire at start. Good judgment must be used as the conditions under which the start is made, such as grade, weight of train and speed, will influence, to some extent, the kind of fire.

After getting away from terminal the fire should be carried level, bright and light as consistent with the work to be done.

In starting from stations at low speeds, blower can be used to good advantage in maintaining maximum steam pressure and a good fire condition. Fireman should closely observe the water level in boiler and handle his fire accordingly.

Approaching pre-determined shut-offs, fireman should stop firing far enough in advance to minimize smoke emission and control steam pressure so there will be no undue waste of steam at safety valves.

The hook, rake or slicebar should only be used when necessary. They are mostly used to correct mistakes.

Shake grate lightly and as often as necessary to maintain fire in good condition.

Fireman should deliver engine at receiving or pit track with fire in condition to clean without undue waste of fire and coke. He should not allow fire to burn so low that engine watchman would have to build up before cleaning.

There are many systems of firing; single scoop, cross firing, banking and others. All that it is necessary to say concerning these different systems is that any system is good where maximum steam pressures are maintained, minimum amount of smoke; hook, rake or slicebar not used, safety valve not opened, and fire in good condition on arrival at terminal.

Stoker Firing

The stoker is a mechanical device and, therefore, the fireman must furnish the intelligence for its operation. The stoker is designed to fire the coal efficiently and economically if properly manipulated.

To become efficient and successful in stoker operation it is essential that all parts be fully understood by both engineer and fireman. The same general principles that pertain to hand firing pertain to stoker firing.

Ordinarily the stoker will distribute the coal evenly over the entire grate surface. Firemen should not be content to sit on the seat as long as steam pressure holds up. He should make regular inspection of the fire to observe the coal distribution, particularly upon leaving terminal stations, by stopping stoker for a few seconds, even at the expense of losing a few pounds of steam. A fire poorly prepared and not watched the first few miles has been responsible for more fuel waste and low steam than any other one item on stoker fired engines, and charged many times to the stoker. The fire can be built up and maintained on sidings and meeting points with the stoker, if intelligently used.

The report was presented by Chairman W. C. Shove, N. Y., N. H. & H.

Discussion

Considerable attention was given in the discussion of this report to methods of maintaining a uniformly thin fire on the grates, which cannot be sloped over six to eight degrees without danger of the coal working forward to the front of the firebox, especially under present high operating speeds, with locomotives sometimes not accurately counterbalanced. One member said that there is no good operating reason for sloping grades and that it is far better to install level grades unless structural or design reasons necessitate using the sloping type.

The question of adequately instructing reemployed firemen, particularly those without experience, was discussed in some detail. Both fuel supervisors and traveling engineers have a large responsibility in this particular which should begin with selecting the most promising material available.

The Function of AB Freight Brake Equipment

A description of the function of this brake not incorporated in its predecessors

Because the members of this association, generally, are more interested in the operation of locomotive and train brakes than they are in the design and in the method of maintenance, this paper is chiefly confined to the handling and to the operation of modern freight train brakes as a whole.

The distinctive features possessed by the AB freight car brake equipment which were not included in former types of air brakes are:

Initial quick service action, which positively closes all feed grooves and initiates service brake action; or, in other words, insures the application of each brake in the train in service brake operation.

Positive and adequate fixed volume secondary quick service applications, which insures a desired uniform brake cylinder pressure on all cars.

Brake pipe surge dissipated.

Stability of brake cylinder values obtained.

Modified degree of quick service on descending grades, giving increased flexibility of control.

Effective stabilization of service application and avoidance of brakes "creeping on," due to light fluctuation of brake pipe pressure.

Accelerated service propagation—propagation speed is substantially uniform with all degrees of tolerable brake pipe leakage, and is more than twice as fast as that of the former standard.

Accelerated release initiative.

Positive release.

Controlled release of brake cylinder pressure at a single fixed and slower rate.

Uniform recharge—accomplished by automatically restricted charge passage under charging pressure.

Emergency brake action more rapidly propagated, with more effective emergency brake cylinder pressure available, under any condition of previous brake application or release.

High brake cylinder pressure in emergency action.

Accelerated emergency brake application propagation rate—about 40 per cent faster than that of the previous standard, or K equipment.

Controlled brake cylinder pressure build-up in emergency action to fit operating requirement.

Positive and accelerated release after emergency brake application.

Protection against train damage if the train brake release is attempted immediately after an emergency brake application has been made, and the train is still in motion, which is accomplished by automatically holding the brake pipe vent valve of the AB operating valve open for a definite time period, thus preventing the brake release.

Quick action chamber adequately guarded against overcharge.

Briefly stated, these modern features provide in actual service operation of freight train brakes:

A service brake application, in which all brakes will apply and during which approximately 10 lb. brake cylinder pressure will be built up in the brake cylinder of each car, whenever a sufficient service brake pipe reduction is made.

During a service brake application, a surge of air

in the brake pipe will not occur and cause some of the brakes to release.

Advantages of greatly improved brake operation, particularly when retaining valves are being operated, when descending heavy grades.

The rate of propagation of service application—in which approximately 10 lb. brake cylinder pressure is built up—is approximately that of the former type brake application propagation in emergency action, very much shortening the time elapsing between the application of brakes on the head end of train and that on the rear end, greatly reducing the probability of undesired slack action.

Positive release of brakes, which is insured by the release insuring feature through the simple method of automatically reducing the auxiliary reservoir pressure sufficiently below that in the brake pipe to force the equalizing piston to release position.

In conclusion, we may add that the above described improvements in brake operation are of such highly efficient qualities and are so apparent to the engineer that practically nothing new in the present instructions to enginemen for the operation of trainbrakes is necessary, particularly so, as all improvements are automatic in action and are readily apparent to the engineer when operating the brakes.

All enginemen in freight-train service should understand, however, that due to the protective feature against train damage after an emergency train brake application has been made, which feature positively prevents the train-brake release from taking place before a specifically allotted period of time has elapsed—if the train brake release is attempted before waiting at least 70 seconds, preferably a little longer, or until sufficient time has elapsed for all vent valves to close, any attempt to release the train brakes results only in a waste of main reservoir pressure.

The report was read by Chairman W. H. Davies, Wabash.

Discussion

Mr. Davies' report was favorably commented on as presenting a lot of information about the AB brake in a comparatively small space. The thought was expressed that owing to the improved functioning of the AB brake it is possible to operate freight trains over the road in substantially less time and that, therefore, this brake must be credited as an important fuel conservation factor. The smooth operation also practically eliminates broken knuckles and draw bars in trains equipped with AB brakes and, therefore, avoids the necessity of cutting out cars for this cause as well as the maintenance expense necessary for repairs occasioned thereby.

Mention was made of the increased charging time required with AB brakes due to the necessity of charging an extra reservoir. This increase in time runs from 3½ minutes to 7 or 8 minutes in some instances. In justification of this increased time, one of the members said that mechanically, as well as financially, it is foolish to expect a large return without some investment. In other words, if some additional time is required for charging the AB brake this is a small price to pay for the important advantages and essential benefits obtained.

The Utilization of Steam Locomotives

Fuel and water supply for long runs—Care needed to avoid surplus power

Everyone is interested in obtaining the greatest possible service from locomotives and it is believed that the items that are of the greatest assistance in intensive utilization are, first, plenty of coal and plenty of water. You may note the high mileage by oil burning locomotives on different roads and of course, in general, they carry about twice the amount of fuel that a coal burning engine carries. Schedules are fast and hard now days and it is proper to consider that you, in a freight engine, obtain about 10 miles per ton; in a passenger engine about 20 miles per ton of coal, with 100 gallons of water per mile in passenger service and perhaps about twice that in freight service so that if you are going to make two divisions, that is say 250 miles, it means in freight service 25 tons of coal and in passenger service if you are going to run say 700 miles it means 35 tons of coal. These are average figures and, considering the reserves that are necessary to protect against excessive delays, weather and especially heavy trains, it seems to enable us to make long runs and that we are going to need about 45 tons of coal, with either water pans that will continually replenish the water or else tenders with possibly trailing tank cars of water to provide a commensurate amount of water.

Discussing through runs it may be of assistance to mention some situations that have developed and the way they have been overcome. Cooperation of the different departments, of course, is essential. That is, if the yardmaster doesn't readily assume his responsibility in getting the engine to and away from the engine house promptly or to and away from the coal dock and ash pit promptly, the motive power department can do little in running engines through because the yard delays will prevent using the engine.

We frequently find two or three different classes of locomotives at a terminal and there is always a thought that one class should be used instead of the other and although one class may be more economical the time that the engines lay at the engine houses due to changing types frequently burns as much coal as perhaps the larger engine would burn even with a light train.

There is always the case of a train of taking off the head end and putting it over in the yard at which time it means faster movements if another engine can be used and if operating conditions require this change perhaps a relay system will keep the engines going to one of the larger points where you expect to hold them for all necessary work.

In some yards there is no air and it has been difficult to run the engines through, because they required the engines to pump up the brakes for test and it could not be spared to go to the coal dock for coal, fire cleaning and inspection.

In one territory, during a short period, there was an excess of power and to avoid light movements this power was taken out of storage and run to the end of the road where it gradually built up and of course an attempt was made to again store it. However, about that time so much of the power had reached the far end of the road that it became necessary to run it back and it

was returned, several engines at a time, so that it broke up the storage. When engines are in service like this it takes some time to get them out and store them, the net result being that substantially more engines were maintained in service than were required, so that if possible permanent storage should be arranged. That is, determine how many excess engines there are and keep them in storage just as long as possible.

One of the best means of determining the surplus of power is a detail study of the time each class of engine lays at the engine house and a determination as to whether it is possible to turn the engines quicker, doing the necessary work, at which time it may be found that, owing to the odd times the trains move, it is impossible to turn them quicker. Then it may be found that these engines can be used for a short time on puller movements or some local jobs that will return them to the engine house in time for the more important work, thus perhaps replacing a smaller class of power which, although burning less coal, means extra engines in service and, inasmuch as it is a less efficient power, may be nearly as expensive to maintain as the larger engines.

This might all be summarized in one of three sentences!

1—Engines must be maintained in first class condition.

2—They must carry coal and water or else obtain it enroute, enough for the full run.

3—The cooperation of all departments is required, if there is to be any measure of success.

The report was read by Chairman A. A. Raymond, N. Y. C.

Discussion

A lively discussion of this report centered on extended washout periods. On one road, passenger locomotives average 15,000 miles a month and freight locomotives 9,000 to 11,000 miles a month with one washout. These locomotives are equipped with two blow-off valves and a sludge remover. Because of extremely bad water conditions, the enginemen are required on the average to blow down locomotives every ten miles for a period of six to eight seconds. Pyrometers are used on most of these locomotives and the attempt is made to keep the temperature of the superheat around 650 deg. F.

On one road, a special study has been made to determine how to obtain maximum service from motive power. A maximum and a minimum number of miles per day has been set for each locomotive class and if locomotives in a pool are not making their minimum mileage the required number are stored to bring the miles up to the maximum miles required. If, however, the locomotives are exceeding the maximum miles more power is added to the pool.

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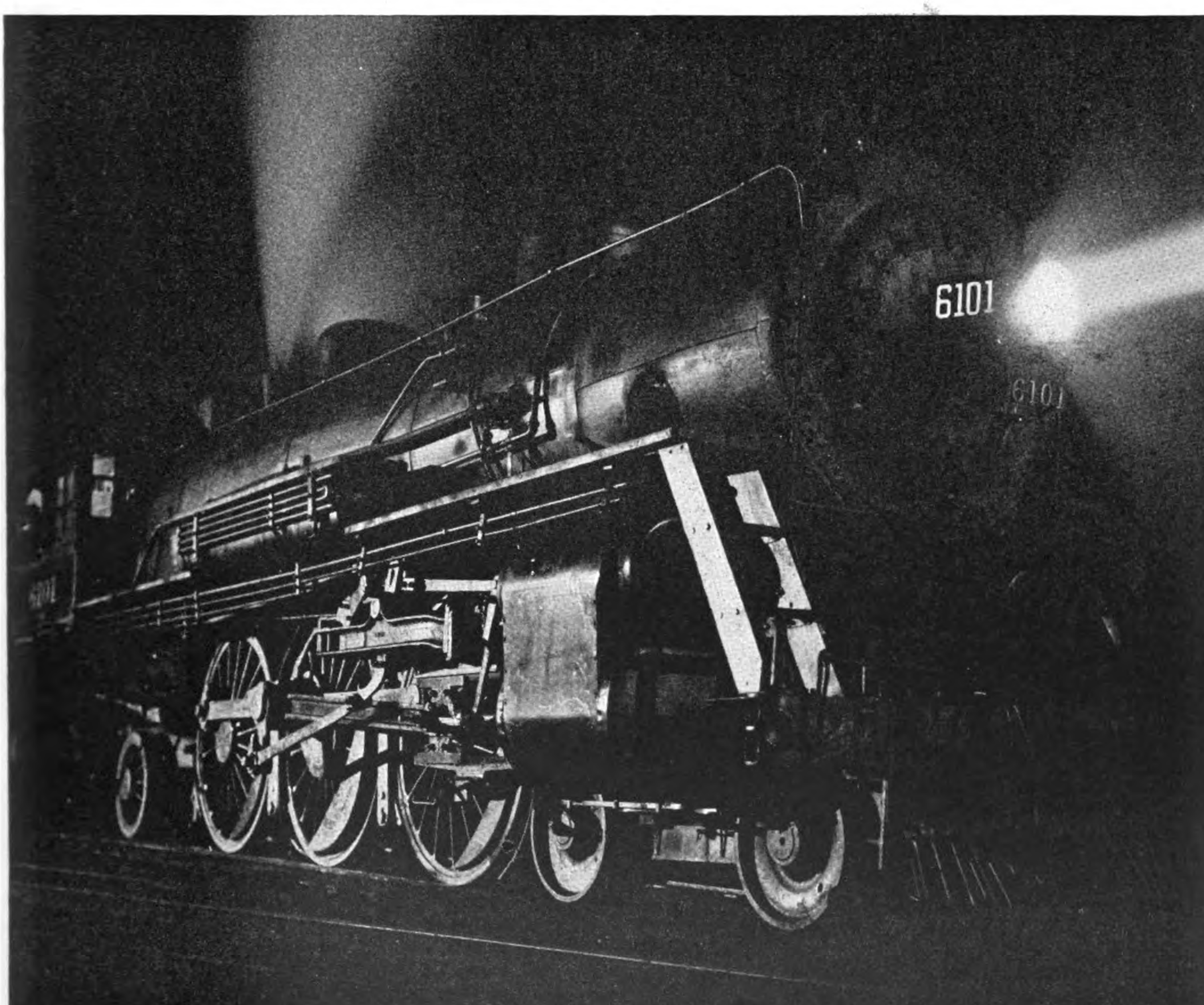

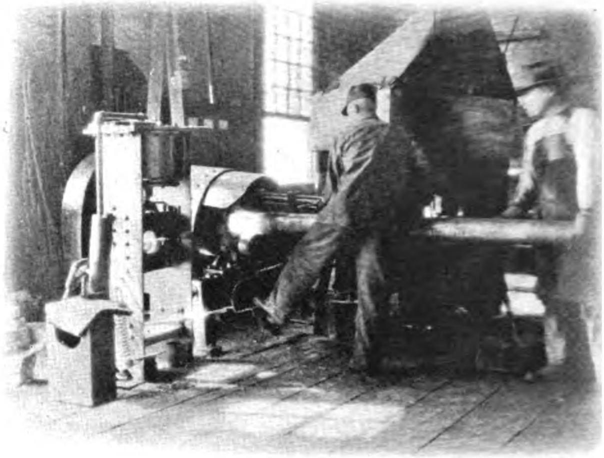

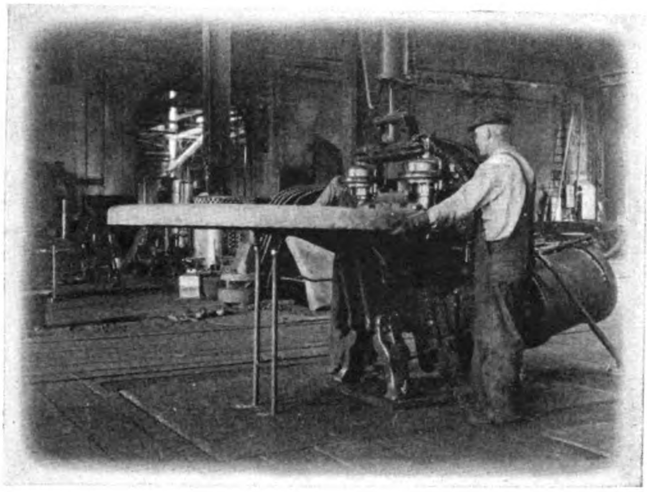

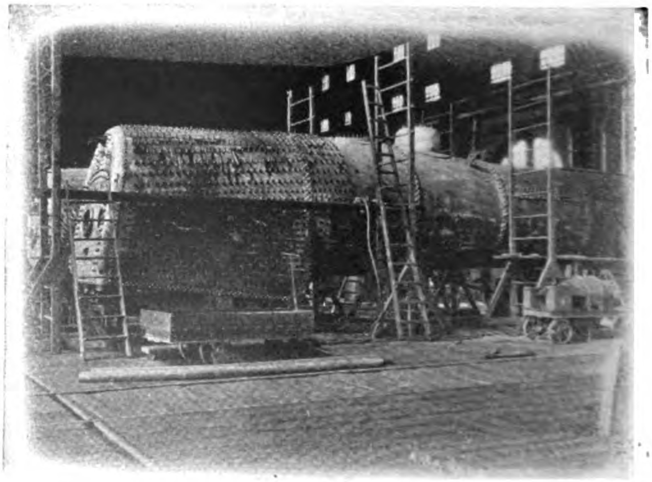

Full Program and Keen Interest Features

Boiler Makers' Meeting

Special consideration is given to apprentice training, welding, effects of bad water and general boiler maintenance problems

THE twenty-fourth annual meeting of the Master Boiler Makers' Association, held at the Hotel Sherman, Chicago, September 29 and 30, was notable for the active discussion of six important topics specifically related to boiler shop operations, with particular emphasis on apprentice training, welding, corrosive effects of bad water, and general boiler maintenance problems.* A total of 150 railroad members and guests registered for the meeting; the discussions were exceptionally interesting and to the point; constructive consideration was given to mutual problems by this aggressive body of railway supervisors who evinced thorough acquaintance with all phases of their work, judging by the amount of detail included both in committee reports and the subsequent discussions.

In opening the meeting, President M. V. Milton, chief boiler inspector, Canadian National, said that no radical change in conventional steam locomotives had yet proved its desirability in practice and that mechanical engineers are confronted with a difficult task in securing further increases in capacity with economy of operation, owing to weight and size limitations. One solution, however, is the use of high-tensile steels which permits going to higher boiler pressures, a subject of great interest to boiler makers as they are called on to aid in the design and at all times maintain locomotive boilers in condition for safe, economical operation. President Milton said that the Master Boiler Makers' Association affords the greatest educational opportunity to boiler foremen in solving mutual problems because it brings together boiler makers from railroad and contract shops throughout the country.

Following President Milton's address E. R. Battley, general superintendent of motive power and car equipment, Canadian National, also congratulated the association on effective work in the past and said that it is largely responsible for improvements in boiler material specifications, design and maintenance, which have been made to date. Mr. Battley made a strong appeal for the training and development of competent railway boiler forces and said that boiler foremen must not think that they have done their full duty until they have developed young men qualified to fill their positions when the need arises. He said that this training takes time, patience and money, all of which, however, are well worth while.

Other speakers who addressed the association included D. C. Buell, director, Railway Educational Bureau, Omaha, Neb.; Colonel C. C. Stibbard, chief operating officer, Board of Railway Commissioners, Ottawa, Ont.; and J. M. Hall, chief of the Bureau of Locomotive Inspection, Interstate Commerce Commission, Washington, D. C. Secretary A. F. Stiglmeier, general boiler department foreman, New York Central, described in his report the efforts of the officers to perpetuate the work of the association during depression years and paid tribute to the many who have helped in this work. He reported that the membership of the association is now 152, an increase of 87 from 1935.

Election of Officers

During the last business session the following officers were elected to direct the association's activities during the coming year: President, W. N. Moore, general boiler foreman, Pere Marquette, Grand Rapids, Mich.; vice-president and chairman of the executive board, Carl Haper, general boiler inspector, Cleveland, Cincinnati, Chicago & St. Louis, Indianapolis, Ind.; secretary-treasurer, A. F. Stiglmeier, general foreman boiler department, New York Central, West Albany, N. Y. M. C. France, general boiler inspector, C. St. P. M. & O., St. Paul, Minn.; L. W. Steeves, boiler foreman, C. & E. I., Danville, Ill., and C. W. Buffington, master boiler maker, C. & O., Huntington, W. Va., were elected to three-year terms on the executive board and L. R. Haase, district boiler inspector, B. & O., Swissvale, Pa., was elected to serve out the unexpired term on the executive board of W. N. Moore, who was elected president of the association.

Mr. Hall's Remarks

President Milton extended the courtesy of the floor to J. M. Hall, chief of the Bureau of Locomotive Inspection, I.C.C. who spoke extemporaneously. Mr. Hall told the members that the bureau had approached the consideration of welding on locomotive boilers with a great deal of conservatism and that, as the art of welding had progressed had gradually lifted restrictions as to welding to keep pace with progress. He remarked that welding is an art but that not all welders are artists and strongly emphasized that every care should be employed to assure the highest quality of work. He told of the background of the design and construction of the recently-built, all-welded, experimental locomotive boiler on the Delaware & Hudson and cited this as evidence of the bureau's willingness to take a broad view on the subject of welding. Mr. Hall expressed satisfaction at the cordial relations existing between the railroads and the bureau. "As Walt Wyre says, 'Don't swallow your cud of tobacco when the federal inspector is coming, because really he's your friend'," said Mr. Hull in closing.

* A paper, "Pitting and Corrosion in Locomotive Boilers," by J. L. Callahan, presented at this meeting, will be published in a later issue.

Colonel Stibbard's Address

Colonel Stibbard told of the work of the inspectors of the operating department of the Board of Railway Commissioners particularly in relation to inspections of locomotives as a means of preventing fire losses in the forested areas of the several provinces of the Dominion of Canada and cited statistics to indicate the value of this work. For example, he said: "In 1919 the total mileage under the board's jurisdiction was 32,720 of which 11,622 were through forested territory. During that year, 1919, there were 1,262 fires in forested territory, resulting in 237,880 acres being burned, with a value of $534,603.

In 1923 the railway mileage had increased from 32,720 to 38,297, and during that year, 1923, there were 1,013 fires with a burnt area of 640,755 acres having a value of $925,850 (not far short of a million-dollar loss in one year). It will be seen then, to what alarming figures the railway caused fires had reached and it was realized that something had to be done to prevent this enormous wastage of the country's natural resources. Accordingly every effort was made to combat this menace by more rigid inspection of locomotives, more frequent fire patrols, better and more up-to-date fire-fighting equipment. As a result of the tightening up of locomotive inspections by railways, Provincial and Board's inspectors the maintenance of fire-protective appliances on locomotives was concentrated upon and from a high of 436 locomotives having defective fire-protective appliances in 1918 the low figure of 28 defective locomotives was reached in 1935. Consequently the value of property destroyed by fire receded from the high figure of almost a million dollars in 1923 to the low figure of approximately $2,500 in 1936, the latter figure being the lowest since records have been kept." In conclusion, Col. Stibbard said, "Perhaps you may wonder why I have dwelt at such length upon fire prevention matters at a conference of this kind. It is because the master boiler makers are the ones who, in the first instance, can contribute the greatest amount of good in this direction. At this conference you will no doubt have sub-committees dealing with such important questions as improved draft arrangement in front ends, nozzle openings, sizes of netting meshes and many other questions pertaining to the front end of locomotives. In all these the question of fire prevention is ever present and must receive its due consideration, and these few remarks are for the direct purpose of reminding you at this time of your responsibility in assisting in the preservation of the forest reserves of the North American continent."

The Training of Boiler Maker Apprentices

The outstanding need in the boiler shop today is young men capable of developing

By D. C. Buell

Director, Railway Educational Bureau, Omaha, Neb.

A timely article in a recent number of the *Railway Mechanical Engineer* states: "The outstanding need in the successful operation of the boiler department today is not tools, equipment, or machinery; it is men, or rather young men—apprentices who are sufficiently interested to be developed in the fine arts of the trade." The article continues by stating, "The question is asked daily in every shop where construction work is done: Who is going to take the layout job when the present layout man quits, or is pensioned? Who is going to be the next flanger, boiler inspector, assistant boiler foreman, and general boiler foreman?" There are many wishers who would be glad to take any of these jobs; but where is the young man who will apply himself studiously, long enough to qualify, even to start on any of the jobs listed?

Analyzing this thought further, what is being done to correct this undesirable condition?

The actual ratio of apprentices to mechanics in the railroad field is 1 to 20. If every one of the apprentices indentured completed his apprenticeship, there would be only enough mechanics made to take care of slightly more than a one per cent turnover. Considering the apprentices who do not complete their apprenticeships for one reason or another a smaller turnover than has just been mentioned is actually provided for. As you know, in handling forces it is the usual procedure to figure on a minimum turnover of at least three per cent.

Let us consider the attention given to apprentices now in service. In the first place have they been selected properly? The proper selection of apprentices is a responsibility which lies with the management. The railroads have had over a hundred years of experience in the selecting and training of employes. Furthermore approximately 45 cents of every railroad dollar is spent on wages. Consequently from a personnel standpoint and from a financial standpoint, this matter should be of utmost importance to the railroad company.

The prospective apprentice is completely inexperienced when he seeks employment and often is only looking for a job, and not necessarily a steady one. On the other hand an applicant may have a strong desire to learn a certain trade. But if there happens to be no vacancy in that craft, it is not unusual for him to be started on an apprenticeship in some other craft, say the boilermakers' craft where there is a vacancy, although he has no desire to learn the boilermakers' trade. He may not be adaptable in any way to learn the trade, and another "misfit" is in the making. He is unhappy in his work and he is costing the company money by "getting by" on the job instead of being interested in his work, and performing it satisfactorily and efficiently. It is his opinion that boiler work is dirty and hard work, with little opportunity for advancement. Not a great deal is expected of him, and he gives less.

No one has told him that if he is acceptable and learns the trade properly (which we will come to a little later), he not only can become a first-class boilermaker but also a first-class welder, a qualified iron and steel worker in a contract shop; that the only difference

between boiler layout work and sheet metal pattern drafting is the consideration given the thickness of the material; that a full-fledged boilermaker should be a qualified inspector; and finally that there are many positions of responsibility with very attractive remuneration in this line of work waiting in vain for qualified, trained men to fill.

For the most part, apprentices are not selected properly on American railroads at the present time. The higher the entrance requirements or standards for apprenticeships, the higher will be the type of young men who strive to secure employment as apprentices. This has been proved on a few railroads during the past ten years.

Training and Advancement

The next question is how are our boilermaker apprentices being trained at the present time, and how should they be trained?

It might not be out of place to mention at this time that probably in no other trade, proportionally speaking, are more helpers advanced to mechanics than in the boilermakers' craft. This is a false solution to the problem. It is no more reasonable to assume that changing the rate and title from helper to mechanic makes a qualified mechanic than it would be to confer the title of Doctor upon a nurse and expect her to perform all the duties of a doctor. Some supervisors follow this procedure, and claim it is satisfactory in emergencies. However, the helper who has been set up to a boilermaker establishes seniority, and becomes a permanent employe classified as a boilermaker, and no steps are taken to prevent a recurrence of similar emergencies. Such a so-called mechanic is nothing more than what is termed on some roads a "specialist," "advanced helper," or "handy man." He is not a qualified boilermaker as specified in the usual agreements between management and the employes.

At the present time boilermaker apprentices are considered in the sense of man-hours on most roads, with little attention given to shop schedules in their practical training and no thought given to technical training. There is a prevailing practice to keep an apprentice on the job which he performs most efficiently, instead of shifting him periodically so that he will receive necessary training in all phases of his trade.

Ratio of Apprentices to Mechanics

The ratio of apprentices to mechanics is of first consideration in working out a proper training program. This ratio should be sufficient to provide at least for the actual turnover on each road.

It has been found that where a modernized apprentice training program is in effect and standard entrance qualifications established, there is no difficulty experienced in securing suitable applicants both physically and mentally for boilermaker apprenticeships.

The apprentice is observed very closely during his probation period to judge his aptitude for learning the boilermakers' trade. If it develops that the apprentice is not showing the proper aptitude for learning this trade, he should be eliminated before the expiration of the probation period specified in the agreement. This should be done in justice to both the young man and the company.

Definite shop schedules should be set up so that each apprentice receives practical training in all branches of the trade. This schedule should be made up to be in accord with the facilities at the shop where it is to be used, and should follow a logical procedure.

In conjunction with his practical shop training, the boilermaker apprentice should also be required to qualify on a definite technical training schedule.

This technical training schedule should include a review of shop mathematics, reading of blueprints, freehand shop sketching, and the fundamental principles of layout problems including parallel-line development, radial line development, and triangulation. This should be followed by practical boiler layout problems. Studies on boiler shop practice should be included in this technical training schedule as well as locomotive inspection, boiler calculations, seams, and patch design.

Competent Apprentice Supervisors

The entire apprentice training program on each railroad should be under the direct jurisdiction of a fully

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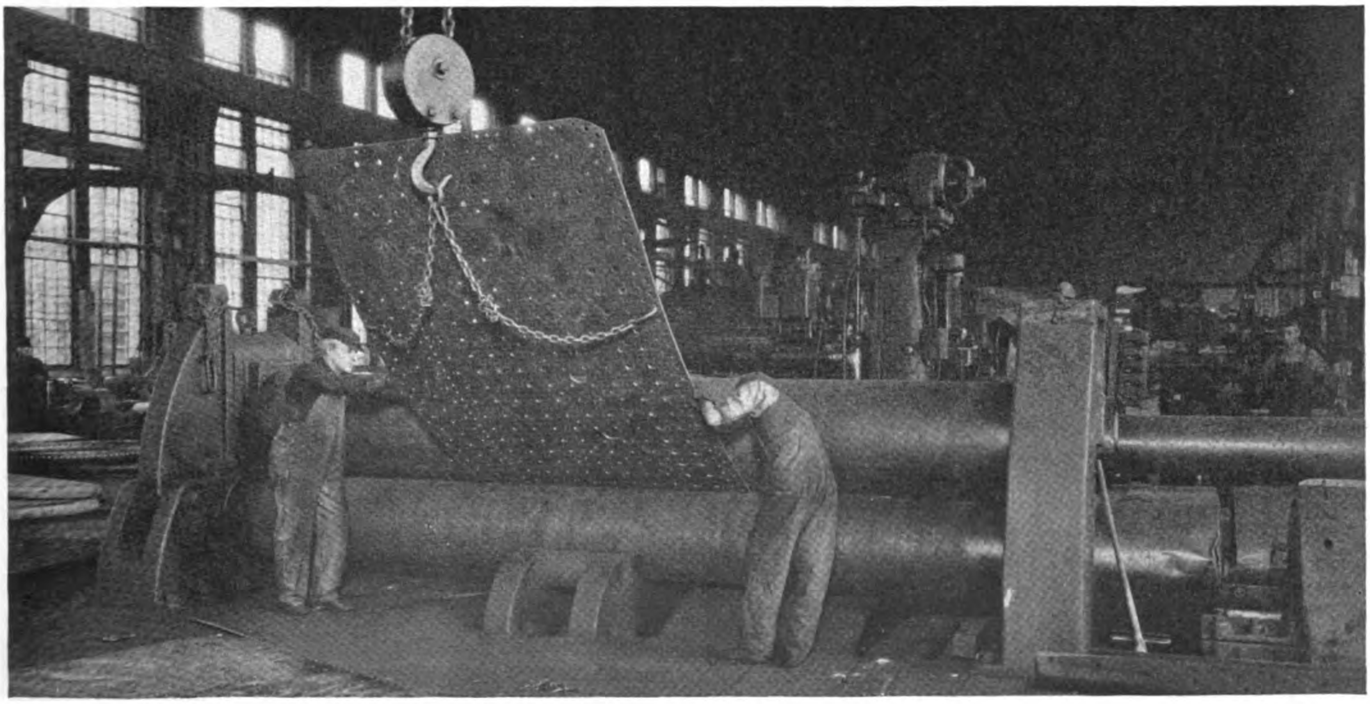

qualified supervisor of apprentices whose responsibility it is to see that the apprentices are shifted properly according to the shop schedule and to see that the apprentices adhere strictly to the study schedule. It is also the responsibility of the Supervisor of Apprentices to see that each apprentice is interviewed individually at least once every thirty days for the purpose of giving each apprentice such assistance as he may require and to test him on previous subject matter. The supervisor of apprentices should be furnished with one or more assistants if necessary to enhance this type of work.

The boilermaker apprentices who serve their time under such a system will be outstanding boilermakers, from whom supervisors and men for special jobs may well be selected.

The fact should not be overlooked that it takes four years to develop this class of mechanic; and by starting a proper apprentice training program immediately, it will still be four years before this type of man will be available.

Pitting and Corrosion of Boilers and Tenders

Committee reports present practice in repairing boilers and tenders

A questionnaire was sent to the leading railroads in the United States and Canada, the questions of which were confined to locomotives built during the past 15 or 20 years. While the committee has endeavored to report on conditions existing on all roads, a difference of opinion was found in some cases; therefore, this report presents the practice in effect on a majority of roads for repairing locomotive boilers and tenders made necessary by pitting and corrosion of the various parts involved.

Smokebox

The average life of a smokebox varies from 12 to 20 years after which time renewals are necessary because of pitting and corrosion from chemicals of sulphuric-acid nature, particularly at bottom of sheets, formed from collection of cinders and moisture or condensation from leaks from various appurtenances in front end, also cinder cutting due to high velocity of forced draft. This action from a chemical standpoint can be overcome to a great extent by eliminating leaks in smokeboxes and by the proper cleaning of cinders.

Some roads build new boilers with smokebox sheets ¾ in. thick with a ¾-in. reinforcing liner which extends approximately to the side center line of boiler. This provides a good support for the cylinder-saddle bolting and also prevents cracking of the smokebox sheet above the cylinder saddle.

The majority of roads continue to build boilers with ½-in. sheet in smokeboxes with either a ⅝-in. or ¾-in. liner extending approximately to the side center line of boiler. Most roads make repairs to the smokebox front, door and liner at the bottom of sheet by application of electric-welded patches.

Tube Sheets and Boiler Shell

The average life of the front tube sheet varies from 10 to 16 years. Renewals were due to pitting on the water side, at the bottom and sides of flanges, cracking in knuckles and enlargement of holes. The cracking at knuckles is due to expansion cracks caused in some cases by a small radius on the flue sheet, and, at times, to excessive rolling and working of flues when holes are enlarged.

Various types of repairs are made such as applying patches at the bottom where pitting occurs at the flanges and the ¾-in. sheet when the locomotive is shopped for classified repairs. Some roads apply patches by cutting through bridges of flues, while others use a scalloped weld. Fig. 1 illustrates different type of repairs.

Pitting of boiler shells is mostly confined to the inside of the bottom shell courses and is more pronounced on the first course because of the application of boiler checks for feedwater. The water on entering the boiler contains dissolved oxygen and carbon dioxide gasses, which when liberated in the boiler are more active at this time and, in our opinion, are contributing causes to pitting in shell sheets.

We have noted circumferential grooving, usually not deep enough to reduce the factor of safety of the shell, which was caused by improper storage of the locomotive.

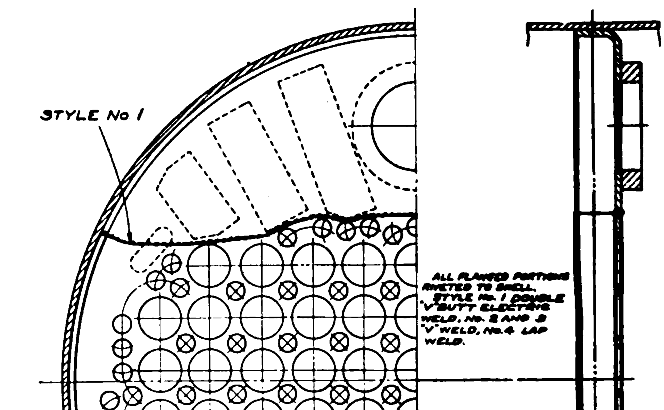

Fig. 1—Repairs to front tube sheet

With the locomotive stored and air-tight, a certain amount of moisture due to atmospheric conditions will form at the top of the sheet on the inside of the boiler. When the air outside is warm this moisture runs down the sides of the boiler causing slight grooves as mentioned. Grooving adjacent to circumferential seams is considered serious if over $^{3}/_{32}$ in. deep as there is a possibility of rupturing the shell at this location due to expansion and contraction. For stored locomotives, it is recommended

that bottom corner washout plugs be removed to permit circulation of air. If the locomotive is stored in a damp place, a pan of unslaked lime should be placed in the firebox and also on top of the flues to absorb the moisture; this will eliminate corrosion of sheets.

Most pitted conditions are repaired by applying patches on the outside of the shell and are more economical than the application of new bottom sections. At times, inside liners are applied for a pitted condition at the bottom of the back-shell course and at the outside throat sheet. This eliminates opening up a circumferential seam at the shell course and the outside throat sheet, which would be necessary if the patch were applied outside. With this arrangement, throat-sheet braces are riveted to the liner and the boiler shell, and set to suit the additional thickness of the liner.

Most of the trouble with pitting or grooving at the back flue sheet, regardless of the type of the boiler, is experienced at the top of the sheet or knuckle. This pitting or grooving usually develops on the water side due to expansion and contraction, and in course of time develops into a cracked sheet.

Repairs are made in some cases, to run out flue mileage, by applying flue-sheet knuckle patches, which patches should be large enough to take in the top row of superheater flues and wide enough to suit the pitted condition. Patches are applied either by cutting through the flue-sheet bridges or scalloped seam.

When the locomotive is shopped for classified repairs, the flue sheet and knuckle patch should be removed, although some roads, if the balance of the sheet is in good condition, apply flues with the original knuckle patch. The life of the flue sheet depends on the type of service, size of boiler and boiler pressure, and varies from 4 to 12 years service.

Crown, Sides and Door Sheets

Some roads report pitting, grooving and cracking at the front end of the crown sheet. Repairs are made by applying electric-welded patches as shown in Fig. 2. The best method in applying these patches is to chip both sides of the patch to a bevel of 45 deg. for a butt double V-weld. After the patch is set in place, the first layer of the weld is applied to the fire side of the sheet; the second layer is applied from the water side and the third from the fire side. Fig. 2 illustrates an electrically welded seam at the crown sheet and back flue sheet; however, the patch may be riveted at this seam in lieu of the welded connection.

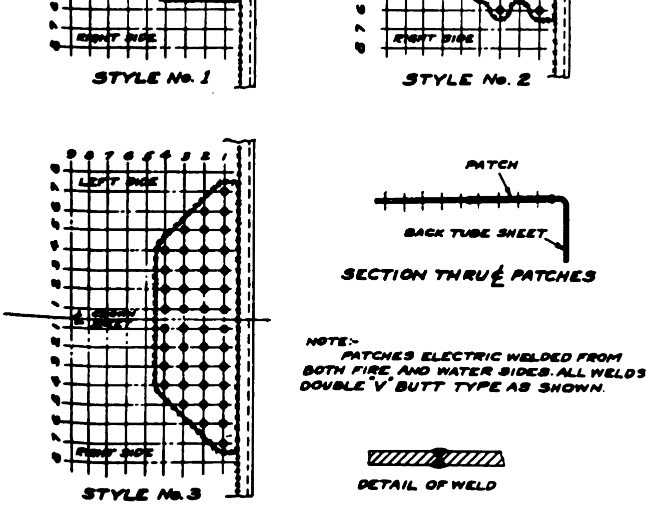

Fig. 2—Crown-sheet patches

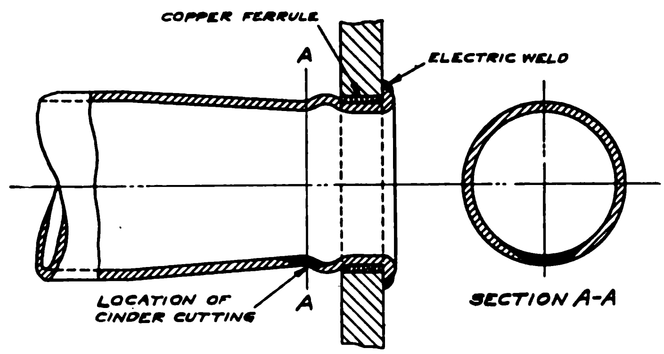

Fig. 3—Cinder-cut flue

Arch Tubes

With modern arch-tube cleaners it is only necessary to turbine tubes at washout periods and their removal is mostly due to brick rubs, although at times they are removed because of blisters or mud burns caused by scale forming on the water side of the tube; however, this latter is purely a matter of improper maintenance. Some roads remove arch tubes at the time of the flue removal although others do not remove tubes if they are in good condition. In our opinion, new arch tubes should be applied when flues are removed.

Flues

The life of flues depends entirely on the type of the locomotive and service required. In certain sections of the country, the full four-years service is obtained with a possibility of an extra year extension, whereas in other sections, with the same type of locomotive, flues are removed in about 2 or 3 years, because of cinder and fire cracking. Fig. 3 shows where this action takes place as caused by high-velocity forced draft and unburned fuel. Cinder-cut flues can be overcome by applying heavier gage safe-ends on new or second-hand flues or new flues purchased with heavier gage at the firebox end, the length of the heavier-gage safe-end is about 12 in.

Tank Cisterns

Pitting and grooving of tank cisterns usually takes place at the bottom and sides along the edges of the angle or tee irons. This is due to water conditions and can be corrected to a great extent by proper water treatment. Bottom and side sheets of coal spaces are subject to corrosion because of sulphuric-acid action from wet coal.

Proper maintenance of splash plates and cross braces will go a long way in prolonging life of the cistern; if bracing is not in good condition at all times serious trouble such as cracking of sheets will soon develop. On new or repaired cisterns it is recommended that a protective coating of paint be applied to water space.

Proper water treatment, whether it be chemical or electro-chemical, has materially increased the life of locomotive boilers and tenders, decreased maintenance cost, eliminated intermediate boiler washes, and in treated-

water districts gives freer steaming boilers due to elimination of scale on firebox sheets and various other reasons.

Discussion

The general report of the committee was read by Chairman L. R. Haase, district boiler inspector, Baltimore & Ohio, with one section presented by J. L. Callahan, service engineer, National Aluminate Corporation and additional extemporaneous discussion by other members of the committee. J. J. Powers, system boiler foreman, Chicago & North Western, said that pitting difficulty on the North Western is now largely overcome due to effective water treatment and the extension of locomotive runs which permits in most cases passing up unsatisfactory boiler water sources. He said that good results have been obtained with the Gunderson electrolytic process, also with certain commercial paints applied to boiler interior surfaces and the use of tannin-treated feed water which is beneficial in retarding the development of caustic embrittlement cracks.

Frank Yochem, chief boiler inspector, Missouri Pacific, raised the question if boiler sheet cracks around staybolt holes, commonly charged to caustic embrittlement, are not in reality due to excessive stresses developed in improper fitting and application of sheets during the manufacture of boilers. This opinion was challenged and also supported to a certain extent by other speakers from the convention floor. Before concluding the discussion a number of well-known railway water engineers and chemists were called on for comments, the general substance of which was that satisfactory railway water conditions cannot be secured without the hearty co-operation of representatives of both the water service and boiler departments.

Preventing Cracks in Back Tube Sheets

Practices which prevent cracks in flange radius and out from flue holes

The committee being familiar with the importance of this subject deemed it best for each member of the committee to submit an individual report covering results on his own and neighboring railroads.

Report by H. A. Bell

This subject includes defects that should be segregated, since the cracks running horizontal are prevalent to a greater extent in poor or bad-water territory, while the cracks running vertical from the flue holes occur in all water districts. The horizontal checks and cracks at the top knuckle of the tube sheet are primarily caused by corrosion—aided by the normal working of the boiler. The vertical cracks and checks from the flue holes are not influenced by corrosion—to as great an extent—and are generally caused from working flues, or location of flue holes too close to the radius of the flange. Both the horizontal and vertical cracks give more trouble on radial stayed, or wagon top boilers, and on high pressure locomotives in hard service.

At different times some or all of the following practices were thought in part responsible for these locomotive conditions: Cold flanging; flanging crossways of the so-called mill grain; not annealing sheets after flanging; too small radius in flange; material too thin; working over flues too hard, and flue holes too close to radius of flange.

A test of hot vs. cold flanged sheets (both properly annealed after flanging) did not show any difference in the life of the sheets in service. But sheets not annealed developed defects quicker than did the sheets that were properly annealed.

Experiments with a larger radius in the flange gave better results, but necessitated moving or leaving out flue holes. Heavier material did not give as good results as did the standard ½-in. sheets.

Treated water and welding reduced the working of flues and helped the vertical cracking, but made no difference in horizontal cracks.

Leaving out or relocating flue holes too close to the flange helped vertical cracks.

Flue sheets having a large (2 in.) radius at the top flange were applied—the rivet row across the top was on a 45 deg. line instead of 90 deg. and the crown sheet was left longer at top front and flanged down over the tube-sheet radius. These applications never developed any horizontal cracks in the top flange of the tube sheet, but did crack the crown sheet horizontally at the firebox calking edge. This was abandoned as it had only transferred the trouble.

Tube sheets copper plated by the oxy-acetylene process (after flanging) was tried without success.

Tube sheets sprayed with zinc by the oxy-acetylene process was tried without success.

Of the items enumerated, the following have been found to be beneficial: Anneal all sheets after flanging. Allow as large a radius in the top flange as possible. Locate flue or tube holes at least 3 in. from the heel of the flange. Reduce working-over of flues as much as possible (expanding and rolling).

The following methods of repair are successful in restoring back tube sheet to the extent explained:

1—Application of a new top portion of sheet by riveting and welding. This repair will generally restore full life to back tube sheet.

2—Crack welded and covered on water side with a riveted or welded cover patch. This repair will generally restore one-quarter life to the back-tube sheet.

3—Crack welded and reinforced by ⅜-in. boiler plate strips 2 in. wide, running from the calking edge of the crown sheet on the water side to near the top of top flue holes, reinforcing strips to be welded all around and located about 6 in. apart, the end strips located just beyond the end of the crack. This repair will generally restore one-quarter life to the back tube sheet. However, this repair should not be attempted except where the conditions are favorable, i. e., where there is only one horizontal crack or check, and the tube sheet is not excessively pitted or corroded.

As a general rule the application of a new ⅛-in. sheet is the preferred repair.

Report by E. E. Owens

This trouble is like pitting and corrosion, it has always been with us and in all probability will continue to be a source of trouble and considerable expense. However, we can devise ways and means of reducing this trouble to a minimum by consultations and expressing

our views at meetings such as the one now being held.

The causes or reasons for defects developing in the back flue sheet are expansion and contraction. As this condition will always be with us, our efforts should be directed to controlling this factor as much as possible. The first consideration should be the selection of perfect boiler plates, uniform in thickness and free from lamination and conform strictly to the requirements of the A.A.R. Specification M-115-36 Grade A firebox steel. While some railroads use steel manufactured by different corporations and which have an alloy content, it has been my experience that there is not much difference in the life or service obtained before the defects develop. Regardless of the kind of steels used, the life of flue sheets depends upon the treatment they receive from the time they are delivered by the steel mills.

There is no noticeable difference between hot or cold flanging if the sheet is properly annealed after flanging.

Proper layout of the flue holes providing a liberal area between holes and flanges is important. At the top where cracks are apt to develop vertically out from flue holes, the limit line between the edge of the flue hole and the heel of the flange should be at least 3 in.

Flue sheets should be flanged to as near a correct and close fit as possible in order to avoid the necessity of heating during the process of fitting up, which heating destroys the annealing qualities.

After the flue sheet is applied we should concentrate our efforts toward insuring proper treatment while in service. In the first place, the flues should be welded to avoid excessive working of them by hot workers. I do not believe any damage is done if flues are given a light expanding with the Prosser expander at monthly inspection periods for the purpose of keeping flues tight in the holes and jarring off scale, provided the boiler is cold.

Care must be taken in engine houses when blowing down boilers, washing and filling them up, to allow for a reasonable length of time for the boiler to cool off, and to see that the temperature of the washout water is not less than 120 deg. F. and the fill up water not less than 180 deg. F.

The boiler should not be crowded nor the pressure raised too quickly when firing up, and after the pressure has reached the proper amount the fire should be watched closely and the pressure maintained as evenly as possible from the time the engine is dispatched until it returns to the cinder pit where the operation of cleaning or knocking the fire should be watched closely. It is my opinion that the abuse a firebox receives when standing around terminals and going over cinder pits contributes largely to all firebox troubles.

As flue sheets are subject to cracking in top knuckles after a given period of service, both vertically and horizontally, the length of service depending upon the class of service, water conditions and amount of abuse a firebox receives through ordinary terminal handling, we should consider methods of repairs which can be made, some of which are more effective than others. It is my opinion that the nature of repairs made should be governed by service requirements. For instance, when we have an engine that has made approximately half of the expected flue mileage, we apply a knuckle patch extending down and taking in one row of superheater flues. This insures against failure during the balance of the expected flue mileage and in most cases permits an engine to run the full limit of four years. Also, when it is desired to keep an engine in service for a few months or until it can be spared and held for repairs, horizontal cracks are cut out and welded from the water side. We have been successful in holding knuckles in this manner from eight to twelve months. The vertical cracks cannot be repaired in this manner successfully. However, this method of repair will permit keeping an engine in service thirty to sixty days. If longer service is desired the flue must be removed, the crack welded and a small patch welded over the knuckle and flue hole from the water side. This method necessitates removal of a part of the front end appliances and is almost as expensive as applying a complete new knuckle, the only saving being in the time engine is held out of service and the cost of one flue as compared with several in an entire new knuckle.

We have tried various methods of prolonging the life of flue sheets, but as yet have not developed any that will prevent them from cracking before the expected flue mileage is obtained. Bronze coating of knuckles with acetylene process prevented pitting but this method de-

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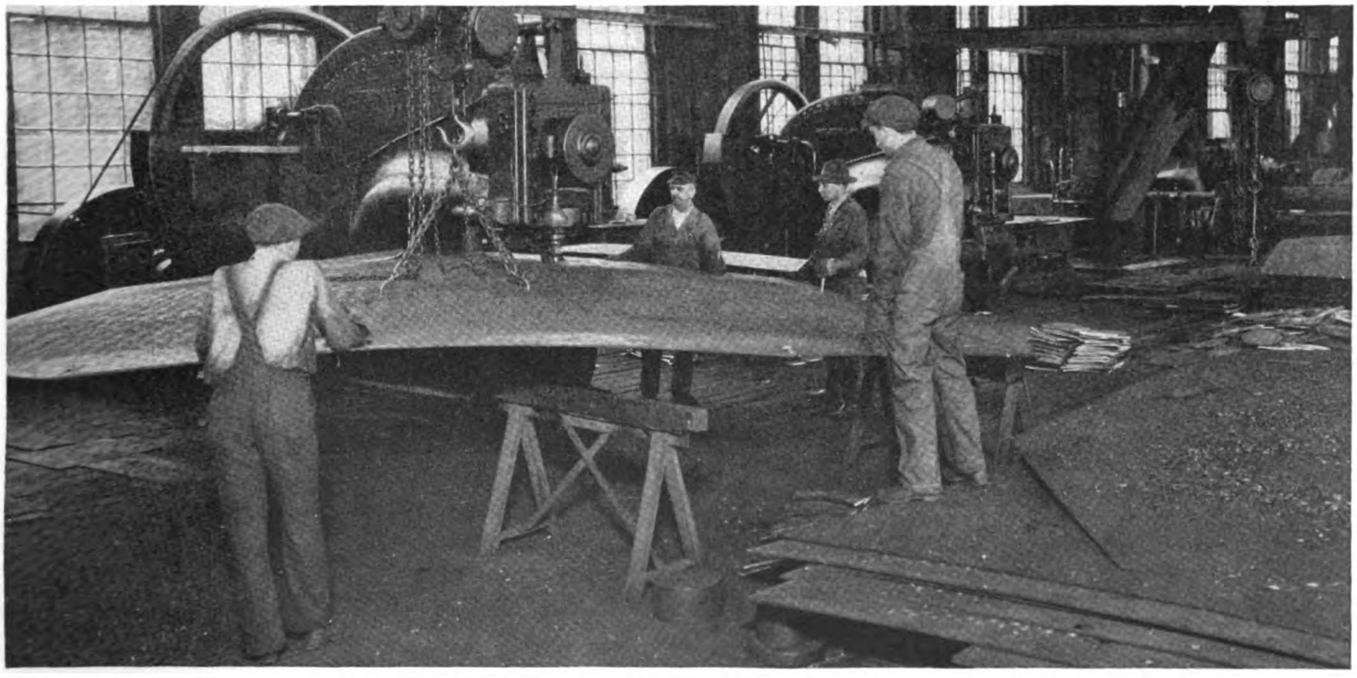


stroyed the ductility of the steel, and horizontal cracks, in some cases, developed earlier in the life of the sheet. We had no more success with a heavy sheet, ½ in. being our standard.

About a year ago we started welding on ½-in. by ¾-in. reinforcing straps over the knuckle on the water side every 8 in. It remains to be seen whether or not we will receive any benefit from this application. However, as I see it, if the knuckle is made strong enough to withstand the bending action, the trouble will be transferred to the end of crown sheet at the flue sheet, the calking edge or through the first row of crown stay holes, and it will then be a question which is the greater evil, a cracked flue-sheet knuckle or crown sheet, and which can can be patched more economically.

Report by G. E. Burkholtz

Cracking in the radius of the back-tube-sheet flange and out from flue holes has been a source of constant trouble to the railroads. The steel used for these sheets is of great importance; steel with low carbon content will give it more ductility and will overcome cracks in the bends. The proper layout of the flue holes, providing a liberal area between the flue holes and the flanges, is also important in preventing such trouble. Flue sheets should be annealed after either hot or cold flanging to relieve stresses. Excessive working of flues can be eliminated by electric welding flue beads on the back sheet, which welding is done primarily to prevent leaking.

Factors which promote cracking of back tube sheets and out from flue holes, by permitting too rapid expansion and contraction, are: Improper drafting, excessive use of the blower, blowing down the boilers too soon after the fires are drawn, the use of cold water in washing boilers, forcing fires too rapidly, and the non-treatment of feedwater.

About four and one-half years ago we made it standard practice to anneal back flue sheets after they were flanged. None of these sheets have cracked in the radius or out from flue holes. Our standard is a ¾-in. radius. We have no set distance from the flange to the flue holes; we make it as much as possible. The method of making repairs on the railroad with which I am associated is to renew the whole sheet if it shows any sign of cracking either in the radius or out of from the flue holes.

Report by L. Nicholas, Chairman

The trouble experienced, and the methods used to make repairs, I find to be the same on the railroad with which I am associated and on neighboring roads, as reported by other members of the committee. The recommendations for preventing such trouble are much the same in each report.

I cannot agree that the welding of flues eliminates cracks in the radius of the flange, as from my experience this trouble started with the welding of beads of superheater flues, which caused sheets to be more rigid and all the stress from expansion and contraction was exerted on the sheet at the knuckle of the flange. So the best we can do to prolong the life of sheets is to keep the surface free of scale, either by using good boiler feedwater, or by a regular period of expanding flues.

We have a few back flue sheets applied which are of an alloy content, one of which has been in service for three years without any indication of checking or cracks, while sheets manufactured of our standard firebox steel have been cracking in radius in less than two years.

Summary

1—Use the best grade of firebox material.
2—Annealing of sheets after flanging.
3—Keep sheets free from mud and scale.
4—Care in use of injector to keep boiler near equal temperature.

Discussion

That the railroads are troubled seriously by cracks in tube sheets was indicated by spirited discussion of this report. The ways and means adopted by many roads to minimize this trouble are well summarized in four recommendations embodied in the conclusion of the report, namely: (1) Use the best grade of firebox material; (2) anneal flue sheets after flanging; (3) keep sheets free from mud and scale and (4) use care in the use of the injector to keep the boiler at uniform temperature. It was also mentioned that direct steaming had had a beneficial effect in preventing cracked sheets. One member ventured the opinion, in conclusion, that flue sheets will continue to crack, in greater or less degree, as long as flues continue to expand and contract.

Proper Thickness of Front Tube Sheets

Committee report on survey of 86 per cent of locomotives in U. S. and Canada

Following the Committee's report in 1936, the railroads in the United States and Canada were again canvassed to ascertain what thicknesses of front flue sheets had been adopted by the various roads; this inquiry embraced 46,267, or 86 per cent, of the 53,984 locomotives owned and operated in the two countries. While last year's report gave the existing practice on the various roads at that time, this year the committee endeavored to ascertain what the same roads would consider the proper thickness for boiler front tube sheets if new locomotives were to be built at the present time. Table I gives the results of the survey.

A total of 56 roads were canvassed and from the replies received the committee has divided the roads into groups A, B, C, D and E. Roads in group A own more than 2,000 locomotives; those in group B own more than 1,000 and less than 2,000 locomotives; those in group C own more than 500 and less than 1,000; those in group D own more than 250 and less than 500; and those in group E own less than 250 locomotives. A summary of the replies received from all the roads is given in Table II.

Compared with last year's report, there is a drop of

Table I — Recommended Thicknesses of Front Tube Sheets for New Locomotives

Thickness of front tube sheet, in....	½	9/16	⅝	¾	⅞
Number of locomotives	6,535	2,745	23,741	13,209	37
Proportion, per cent	14.12	5.94	51.31	28.55	0.08

NOTE: This table is the result of an inquiry made to ascertain what the railroads in the United States and Canada would consider the proper thickness of front tube sheets for new locomotives.

Table II — Summarized Replies on Thicknesses of Front Tube Sheets Adopted by Various Railroads

Line No.	No. of Locos.	Thickness of front tube sheet, in.	Remarks
1	E	3/4	Adopted this thickness 16 yrs. ago. Previously used 1/2 in., the latter gave trouble due to cracked knuckles and bulging.
2	B	1/2, 9/16, 5/8	The boiler pressure and area to be supported governs thickness of sheet. Boilers with 310 lb. per sq. in. pressure have 5/8-in. sheets. On lower pressure boilers 9/16-in. and 1/2-in. sheets are used.
3	C	1/2, 9/16	Experienced some cracked knuckles due to use of small radius flange. Now using 1 1/2 in. radius which increases life but sacrifices some flues.
4	A	3/4	Occasionally experienced circumferential cracks in knuckle at bottom and sides of sheet. Have some sheets 27 yrs. old and still good.
5	E	3/4	For new locomotives the preferable thickness is 3/4 in.
6	C	1/2, 9/16 5/8, 3/4	Governed by builders' practices based on past successful experience. Shops report no trouble with various thicknesses. Probably favor 9/16-in. sheet.
7	A	5/8	Standard for all modern locomotives.
8	A	5/8	Occasionally have cracking and grooving at heel of flange. General cause for renewal is enlarged and distorted tube holes.
9	E	5/8	Recommend 5/8 in. as proper thickness for all future locomotives. Apply riveted ring to shell and weld flat sheet to ring using gussets on lower portion.
10	B	3/4	It is our opinion this provides proper bearing for flues and sufficient strength for high-pressure boilers.
11	E	3/4	Account higher pressures and possible use of type *A* superheater would use 3/4-in. sheet.
12	B	5/8, 3/4	All superheat locomotives have 5/8-in. sheets; however, nine new 4-6-4 type with 300-lb. pressure will have 3/4-in. sheets.
13	B	5/8	We believe this is the proper size for new equipment or for replacement of existing sheets.
14	E	5/8	This is considered the proper thickness for new equipment.
15	B	3/4	Would consider this standard for new equipment and for renewals in boilers 72 in. in diameter and larger. Have made a few replacements with riveted ring and flat sheet.
16	C	5/8	This is standard except where heavier sheets are required or lighter would be satisfactory when a saving in weight is desired.
17	D	5/8	Have experienced cracks in knuckles which vary in length from 4 in. to 50 in.
18	D	5/8	This is representative practice and was used on a recent passenger locomotive with a boiler pressure of 325 lb. per sq. in.
19	D	3/4	Have obtained very satisfactory service with this thickness, and it has been adopted as standard for all new equipment.
20	D	5/8	New passenger and freight power now under construction will have this thickness; it will also be considered for future power.
21	D	5/8	No comments.
22	C	5/8, 3/4	Either thickness may be used depending on the bracing applied and pressure carried. Both thicknesses were used on recent locomotives.
23	D	3/4	Recommend this thickness for new equipment.
24	B	5/8	This is now standard for all locomotive boilers including replacements.
25	B	5/8, 3/4	Boilers up to 225-lb. pressure have 5/8-in. sheets and those above that use 3/4-in. sheets. Have some trouble with cracked knuckles in lower portion.
26	E	1/2, 9/16, 5/8	All three sizes are used on saturated locomotives varying according to diameter of boiler. All superheat locomotives use 5/8-in. sheets. All sheets are annealed after flanging.
27	C	5/8	Based on experience would in future use this thickness. Have trouble with cracks in knuckle in bottom portion.
28	B	5/8	Consider this the proper thickness for any new locomotives that might be purchased. Sheets flanged hot and annealed.
29	D	5/8	Recommend this thickness for all new locomotives.
30	D	3/4	Present practice is 5/8-in. sheets, new locomotives will have 3/4-in. sheets. All annealed, both before and after flanging.
31	E	5/8	This practice followed on all locomotives and found to be most practical for all purposes.
32	E	5/8	Front tube sheets on new locomotives should be at least 5/8-in. thick.
33	B	3/4	Would use this thickness on new locomotives. No trouble experienced except due to corrosion.
34	E	3/4	Recommend this thickness, applied if possible without flanging or riveting.
35	A	5/8	This is standard, being used on some recently built switchers, and is also being used on passenger locomotives now under construction with boiler pressure of 275 lb. per sq. in.
36	D	3/4	The use of different thicknesses is probably the outgrowth of various experiences, some of which can no doubt be accounted for by unsatisfactory service of some kind resulting from causes quite apart from the thickness of the sheets.
37	C	5/8	This thickness is most desirable for modern locomotives.
38	C	3/4	This size is more desirable than thinner sheets, since it gives better contact with the tubes, stronger bridges, and prevents buckling. Flat gusseted sheets welded to riveted rings are used.
39	C	3/4	Considerable trouble experienced with 5/8-in. thick sheets due to cracking; 3/4-in. sheets last indefinitely. Use this on all new equipment, and for replacements; a 1 in. fillet is best.
40	A	1/2	9/16-in., 5/8-in. and 11/16-in. sheets are also used, but these give no better service than the 1/2-in. sheet. Some trouble was experienced with cracked knuckles at bottom in boilers with 2 1/4 in. flues 19 ft. long. A 2-in. radius flange and a separate short course for the front flue sheet are used.
41	E	5/8	Prefer the 5/8-in. sheet and nearly 60 per cent of their locomotives are so equipped; the remainder have 9/16-in. and 1/2-in. sheets. Have not experienced any particular difficulty with the 5/8-in. sheet.
42	B	5/8	Use this thickness regardless of boiler diameter and pressure; bridges 13/16 in. minimum. At present not experiencing any trouble.
43	B	3/4	Due to high pressure modern power carries, front tube sheets of 3/4 in. thickness are preferred unless special steel is used.
44	C	5/8	This thickness is quite satisfactory and is being used on some new 250-lb. boilers now under construction. Sheets are flanged cold and then annealed at 1,500 deg. F., this was found best after test of various methods.
45	E	5/8	Never used sheets any thicker than 5/8 in. When they had epidemic of cracked knuckles they applied patches with gussets. Last 4-8-4 type locomotives were weight restricted or they might have used 3/4-in. sheets.
46	C	3/4	No comments.
47	B	5/8	Consider this proper for large locomotives, and new locomotives ordered last year have 5/8-in. sheets. Have experienced cracked knuckles and have corrected them by increasing the radius to 2 in. Applied a 3/4-in. sheet about 11 yrs. ago and no trouble reported.
48	B	1/2, 9/16, 5/8	On saturated locomotives with boilers below 75 in. diameter, use 1/2 in. sheets, and with boilers between 75 in. and 80 in. diameter use 9/16 in. sheets. Larger boilers and all superheat locomotives have 5/8-in. sheets. Have a few exceptions.
49	D	3/4	This is standard for all classes and giving good service. Recommend adoption as standard.
50	B	5/8	This thickness of front tube sheet used for all new equipment.
51	E	3/4, 7/8	Recommend 3/4-in. sheets for new simple locomotives and 7/8-in. sheets for mallets, with inside radius of knuckle at least 3/4 in., but preferably more.
52	D	1/2, 5/8	Consider 1/2 in. sheets to be satisfactory on saturated locomotives and 5/8 in. sheets for superheat locomotives.
53	E	5/8	Will specify this thickness for new equipment. Formerly used 1/2 in. but discontinued because of cracked knuckles and some bridges.
54	E	3/4	This thickness will be used in the future on all large locomotives.
55	E	5/8	Consider this the proper thickness. Sheets are flanged cold and annealed at 1,650 deg. F. In winter sheets are preheated to 900 deg F. before flanging on machine flanger.
56	D	3/4	Adopted as standard for all front tube sheets. Trouble at a minimum. Sheets are normalized at 1,625 deg. F., which prolongs the life and relieves strains set up in flanging.

62.8 and 32.7 per cent, respectively, in the preference for the 9/16-in. and 1/2-in. front tube sheets; however, the preference for 5/8-in. and 3/4-in. sheets have increased 31.6 and 19 per cent, respectively.

The most prolific source of trouble continues to be cracked knuckles, which exist in all thicknesses of sheets used; however, those roads which use the 5/8-in., 9/16-in. and 1/2-in. sheets report a great deal more trouble in this respect than the roads using sheets 3/4 in. thick. As there are more 5/8-in. sheets used than any other, this naturally helps increase the number of trouble reports for this size sheet over the reports for sheets of the three lowest thicknesses used.

Those roads which exercise the most care in flanging, by proper annealing after forming, report less trouble from cracked knuckles. Regarding hot and cold flanging. one road reports a definite test showed that cold flanging and annealing is superior to hot flanging and annealing.

Regarding the material specifications, most all the roads use steel of A.A.R. Specification No. 115 of latest revision or their own which is very similar in physical and chemical characteristics.

A few roads are trying a flat riveted ring in the first course to which a gussets flat tube sheet is welded, thus eliminating the knuckle entirely. This method is standard on one large road and has given very satisfactory results.

Recognizing the many conditions which give rise to front-tube-sheet problems, such as the various diameters of boilers, lengths of flues, expansion and contraction, and steam pressures carried, this committee hesitates to recommend one standard thickness for all cases, but firmly believe either 5/8 in. or 3/4 in. would be suitable for any condition, bearing in mind that practically 90 per cent of the replies expressed satisfaction with those thicknesses with the 5/8 in. sheet being in the majority. The radius of the flange should be not less than 1 in. nor more than 2 in., dependent on the closeness of flues to knuckle.

Safe-Ending and Applying Flues and Tubes

Committee report on modern flue-shop practices which aid in reducing maintenance costs

The committee sent out 100 questionnaires to members of this Association to obtain a complete summary of standard practices followed in the safe-ending and application of flues and tubes. The committee learned that as a rule each individual road has a standard procedure to be followed, and that a number of roads have not taken advantage of the most economical method of safe-ending flues, which the committee found to be the electric-welding method.

Until recent years, it was customary when safe-ending flues and tubes to prepare them by methods shown in Fig. 1 and, after bringing the parts to a welding heat, to complete the weld on a mandrel of a pneumatic welder by rolling or hammering. This method limits the production to a small number of flues or tubes per hour per two men.

The Committee has investigated the various items entering into the cost of safe-ending flues and tubes and has found that machinery builders today have constructed their machines with the idea of bringing the flues to each machine, and taking them away as rapidly and efficiently as possible.

As an illustration, one machine was developed for cutting off safe ends of flues. This machine will cut off a 2-in. or 2 1/4-in. flue in 2 sec. and will cut off a 5 1/2-in. or 6-in. flue in about 5 sec. Therefore, the problem is the handling of the flues to and from this machine in a rapid and efficient manner; thus, enabling the machine to work at its full capacity. With this thought in mind, a complete unit was developed by Joseph T. Ryerson and Son which takes the flues off the floor and eliminates handling by manual labor almost entirely. After considerable thought, a design was worked out consisting of what are known as "flue tables," and again, with the idea of eliminating manual labor, these tables were arranged so that the flues would be propelled by gravity to the various stations where the various machines are located. At the point where the flue stops, preparatory to entering a certain machine, a device was developed which picks one flue at a time from the flue table, places it by mechanical means on a power-operated roller, rolls it into the machine, returns it to the flue table, and sends it on its way, all of these operations being performed without a man having to lift or move the flue by hand.

After the flues and tubes are removed from the boiler they are placed on flue tables or racks. Several sets of

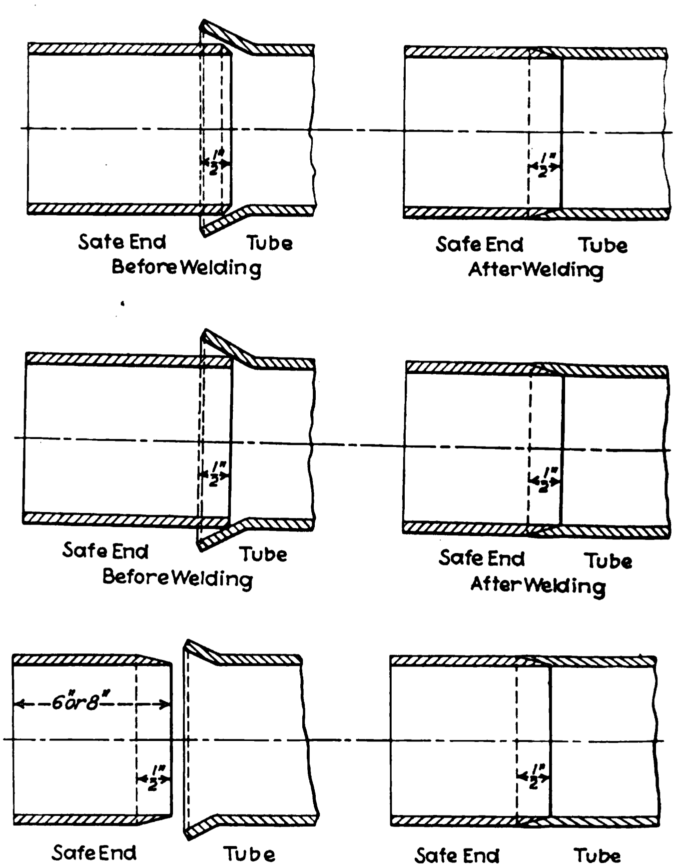
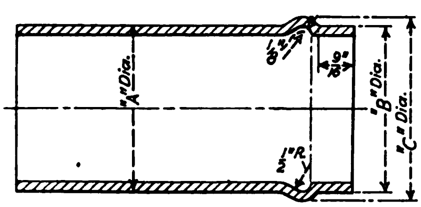


Fig. 1 Obsolete methods of safe-ending flues

flues can be loaded on these racks ready for the first operation, which is cutting off one end using a No. 0 Ryerson high-speed friction saw. After one end is cut off, the flue is lifted by an air jack and turned end-for-end; then the other end is cut off. The flues then roll to a rack leading to a sand-blast flue cleaner. At this point the flue is picked from the flue table and placed on the power-driven rolls which carry it into the Ryerson scale-cracking machine. This scale-cracker consists of three knurled crushing rollers, each of a different pitch and actuated by a cam which maintains a uniform periphery; the three rollers are adjustable, the opening of which can be made to take any size flue or tube into a sand-blasting machine which has an entrance and an exit hole for the flue to pass through. The cabinet of the sand-blast machine is rubber lined to prevent damage from the blast. This cabinet has seven adjustable nozzles with openings of ⅛ in. for air and ½ in. for sand. The flues enter the cabinet from one side and are rotated as they pass through; the sand blast removes all the scale untouched by the cracking rolls, and it also blasts out any of the pitting in the flue in which scale has collected, and exposes these pit marks to their extreme depth. The sand blast is arranged so that it will not injure a new tube nor will it remove any metal from the tube itself, as the nozzles strike a glacing blow, rather than a direct one, and the action of the sand has a tendency to peal the scale rather than to blast it. The speed of travel through the sand-blasting machine is approximately 22 ft. per min. for a 2-in. tube; 20 ft. per min. for 2¼-in. tube; 16 ft. per min. for a 3½-in. tube; and 14 ft. per min. for a 5½-in. tube.

The speed of travel through the sand-blasting machine



A	B	C	Nominal Dia. of Flues
4½"	4½"	4¾"	5⅜" and 5½"
3"	3"	3¼"	3½"

Fig. 2 End of flue or safe end after being prossered

can be regulated at the time of installation to handle the required output of flues per month, and the speeds of the flue-cracking and pulling machines can be adjusted accordingly. All of the machines in the set-up operate faster than the sand-blast cleaner; thus, when regulating the cleaning by either increasing or decreasing the speed of the sand-blast cleaners, the speed of the balance of the machines can easily be made to handle the output. After sand blasting, the flue enters the Ryerson flue-pulling machine which is the same as a scale-cracking machine, only with smooth instead of knurled rollers. The flues or tubes are then inspected and those found light in weight, pitted or corroded to any extent are scrapped.

After leaving the sand-blast cabinet, the flue rolls down to the welder. The flue is brought into the welder and onto the roller by power-driven rolls. After welding and rolling the flue is removed from the machine by the power rolls and actuating cams at this point remove the flue from the rolls and place another flue on them. These power rolls are operated with a reversing-type motor, the reversing switch of which is conveniently located near the operator's hand so that he has complete control of the movement of the flue to and from the welding machine. The Ryerson flue-rolling machine is operated with an air cylinder controlled by a foot-operated pedal conveniently located near the operator's foot.

As the flues leave the welder, they again roll by gravity down to the testing machine, then roll down again by gravity to the swedging furnace where they enter from the side. They are then heated and swedged and continue on down the flue table to a point where the second friction saw is located for cutting the flues to length.

Five men, including the supervisor, are needed to operate the flue shop just described. This number of

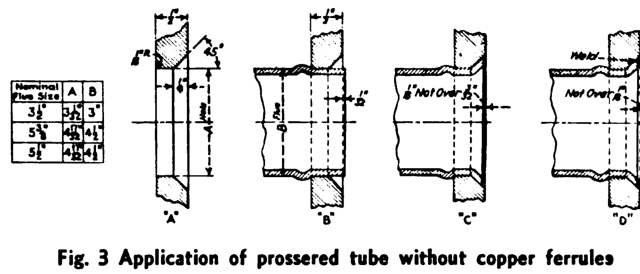


Fig. 3 Application of prossered tube without copper ferrules

men could take care of between 8,000 and 12,000 flues per month, on an 8-hr. shift. The space required will run about 100 feet square, but various layouts can be made to use irregular space in the shop if space 100 feet square is not available.

It has been found possible to take care of the flues and tubes of from 1,000 to 1,200 locomotives on one welding machine by operating it day and night. It is possible to take care of all sizes of tube and flues on one welder, but it is necessary to change the dies to suit the particular diameter of the work. An up-to-date electric flue welder is absolutely flash proof, thus insuring long life to the winding and bearings, and all moving surfaces slide on hardened and ground steel plates, thus assuring perfect alignment as well as a perfect distribution of current around the circumference of the work. The number of flues that can be welded varies from 60 to 100 per hr., but again this is based entirely on the ability of the shop to bring the flues to the machine and take them away in as rapid a manner as possible.

The troublesome ridge on the inside circumference of boiler flues and tubes, formed by rolling-in the slag from the resistance butt welds of safe-ended flues when working the hot weld over a mandrel between a set of rolls, has been eliminated successfully at the West Albany shops of the New York Central System by the simple expedient of blowing the slag from the resistance weld by a blast of air during the flash period. This method was completely described in the July, 1937, issue of the *Railway Mechanical Engineer.*

One of the new features in the application of 3½-in., 5⅜-in. and 5½-in. diameter flues is the expander machine, which does the work of the sectional expander. Putting in this prosser, shown in Fig. 2, is done hot in this machine during the swedging and welding of the safe ends. It is not rolled in—the tool in the machine gives a pushing motion as the rollers of the machine revolve. The tool revolves from a central position feeding to its full radius once in every four turns after which it again recedes to its central position so the flue can be withdrawn. This is done so that the flue will not thin out. By putting the prosser groove in the tube or safe end while hot eliminates all the formation of longitudinal cracks, and effects savings by not having to expand them by manual labor. It is difficult to expand these large flues and besides there is a stress set up which is not set up when the flue is prossered hot before application by this method.

One of the chief causes of trouble with superheater flues applied with copper ferrules, setting, belling, expanding, beading and welding around flue beads, is that

more or less trouble is experienced by welds breaking away from flues or sheets, and flues cracking longitudinally into the prosser marked.

In December, 1936, the Southern Pacific adopted its present method of applying superheater flues, eliminating the above mentioned trouble. The holes in the back flue sheet for superheater flues are countersunk at a 45 deg. angle half way through the sheet, as shown in Fig. 3*A*. In applying flues to the boiler, the prosser which is formed on the small end while the flue is hot, is set snugly against the back tube sheet as shown in Fig. 3*B*. The back end of the flue is flared out with a peen of hammer to hold them in position in the sheet, and rolled to a snug fit, care being taken to prevent excessive rolling, as a snug fit only is required. Flues are then flared out to a snug fit in countersink of the sheet as shown in Fig. 3*C*. The flues are then electric welded with one good substantial bead as shown in Fig. 3*D*, fusing well into the end of the flue to make a strong welded joint. There is no projection of the weld on the firebox side, as this weld is flush with the sheet and will run the life of the flues or the back-tube sheet without giving trouble. With this method, no ferrules are used in the back tube sheet for superheater flues.

Discussion

In the discussion of this report, a question was raised as to the results being obtained by the different roads in applying flues and tubes without the use of copper ferrules. A number of members reported that they had followed this practice and that it had so far proved entirely satisfactory.

It was also brought out during this discussion that only about 25 per cent of the roads represented at the meeting were still safe-ending flues by the mechanical method involving the use of oil or gas furnace and hammer and that the remaining 75 per cent are now using the electric welding method.

Preventing Firebox Sheets Cracking Out of Staybolt Holes

Committee report discusses improvements made in the application of staybolts to prevent cracking of sheets

This committee report is submitted in three sections with comments by Chairman C. W. Buffington, and committeemen H. E. May and R. M. Cooper.

Report by C. W. Buffington

Years ago staybolt holes were reamed and tapped by hand, and staybolts were run-in and driven up by hand; good threads, good fit, and good driving were demanded. Bolts were spread in the holes by driving in the center; then the edges were turned down. With all this care the staybolts leaked and had to be redriven repeatedly, and this caused continued leaking, which should be expected, since the bolts were driven against the sharp edge of the hole.

There have been improvements in the tools for staybolt application. We now have air tools to do this work; this has speeded up the work but has not improved the application. The U. S. form of thread is now being used instead of the V-type to facilitate application, but this reduces the holding power in regard to leakage. Only half sheets have been applied to overcome this, but they have failed to give results. Combination and taper bolts have been applied to take care of large holes, but I have never considered this the solution.

When the flanged type of staybolt hole was suggested, I thought it was the remedy and still think so, for several reasons. The trouble we have had with combustion tubes was not solved until we tried the flanged type of hole; this was the starting of the idea for the flanged type of staybolt hole.

In the flanged type of staybolt hole we have obtained the extra holding power. We have approximately ½ in. of thread in sheet, bolts can be set longer and a good head can be applied because it is driven into the radius formed by flanging the hole; the bolt is submerged against fire action and is protected by being recessed in the water space. You will note that all these points cover the things necessary to improve the application.

We made such an application on two engines in 1933 and both engines have given good results. One of these was a large freight locomotive in service on the mountain division. It was never necessary to repair these staybolts while in service. This engine has made a cycle of mileage and no staybolts were removed in the flanged-type of staybolt holes; however, 33 were removed when it came in the shop for class 3 repairs to inspect holes to see if any defects had started. No defects showed in the holes on either the water or fire side. This is the first time this has ever been done with this type of engine.

Report by H. E. May

The following report incorporates changes made in the past seven years in the maintenance of locomotive boilers on the Illinois Central. Prior to that time, conditions were as follows:

Washing of boilers was done in a very crude and haphazard manner—boilers were blown off in any way most suitable to the purposes or desires of any of our men handling work on locomotives, and were drained completely and allowed to stand empty, baking scale on interior surfaces while cooling. Washing was done with pressures ranging from 25 to 50 lb. per sq. in. with nozzles of every description. Temperature of washout water ranged from atmospheric to about 150 deg. F., and fluctuated rapidly due to lack of uniform maintenance of the supply, and the amount used. Water was heated by the water and steam blown from boilers, and when the level dropped to a certain stage, fresh water was added. Heating, therefore, was only as uniform as the space of time between each blow-down affected the supply.

The staybolt breakage during this period was very great because of strains set up by rapid change in firebox or boiler temperatures. Boilers were washed not less frequently than once each week, with one or two water changes were made on an average between each washout period.

The attention and repairs required in fireboxes were such that a locomotive was looked over for boiler work before the enginehouse foreman could figure on any locomotive at any time for a given run, due to side sheets, door sheets, flue-sheet flanges, syphons and rivet seams

cracking or leaking, and also because of the regularity with which badly leaking flues were found in fireboxes.

Large scale banks were found in barrels of boilers, between flues, between side sheet and casing sheet, between side sheets of thermic syphons, as well as around mud ring, and a heavy coating of hard scale on all sheets. This caused flues to collapse, side sheets, door sheet, flue sheet and syphons to blister and fire-crack, and fireboxes in general to require such an amount of repairs each trip that they could not be regarded as in other than a poor condition.

With a view to correcting these conditions, a complete change of methods was adopted, including the following:

Washout pressure at the pumps was increased to 200 lb. per sq. in.

Washout nozzles of a standard design were placed in use to insure the complete washing of boilers; nine nozzles in all were designed for this purpose to take care of all parts with a minimum amount of changing from one style to another, and the nozzles were placed at every point where boiler washing is done, regardless of the fact that some small terminals would only use them two or three times per month.

By maintaining 200 lb. pressure at the washout pump, we were assured of 100 lb. or more at the nozzle with water flowing through outlets at all locations in the shop. This, coupled with the heating of washout water to a temperature of not less than 120 deg. F. brought about a speedy improvement in the condition of boilers and fireboxes.

Washout periods were then extended to 15 to 30 days between washouts. This proved unsatisfactory at some points due to scale and mud in the water supply, although methods were adopted to blow boilers while in service, or while lying at terminals, to dispose of mud and scale or sludge accumulation in the mud ring.

At this time, locomotives were equipped with two blow-off cocks, located at the front of the firebox, right and left side. These cocks were ample to take care of the removal of this waste across the front mud ring and down each side sheet for about 36 in., but would not remove scale or mud which had accumulated across the door sheet and along sides to the above-mentioned location. In these locations, it was found that ten days was the limit between washouts if mud burned sheets at the back of fireboxes were to be avoided.

A locomotive was then selected at a point which was giving us the most trouble from this source and the left blow-off cock was moved to the left back corner of the mud ring. Tests were then made as to the effect this would have in eliminating deposits at this section of the mud ring, and while the condition was improved, it was found that the application of a perforated pipe across the length of the back mud ring with direct connection to blow-off cocks was necessary to provide proper suction over the greater area involved. Holes of different sizes were drilled into pipe, increasing in size uniformly with the distance from the blow-off cock to provide the same suction from the right half of the back mud ring as from the left side, near the blow-off cock. The operating lever to each blow-off cock was placed inside of cab, where locomotive crew could operate them without moving from their seats, and with proper leverage to make it possible to open or close them with one hand. Piping arrangement and a muffler were installed so that blowing could be done at any point desired, in operation on the road, or at terminals.

With the advantages these combined appliances produced, it was found that all locomotives could be operated 30 days between washouts without an accumulation of any kind that would be injurious to the sheets. This advance to a 30-day washout period, and the elimination of all improper blow-off practices, allowed us to restore the boiler water to such a concentration that with proper chemical treatment of water that contained a high percentage of hardness or other injurious content, these factors could be allowed to carry on their work in breaking down the scale so it could be blown out instead of collecting or fastening tightly on the sheets.

Variation of the water supply that gets out of control of these reducing factors is checked closely on each washout inspection, and any increase in the amount of scale found is reported on regular inspection report sent to the general locomotive and boiler inspector. These reports are then consolidated and an abstract given to the water

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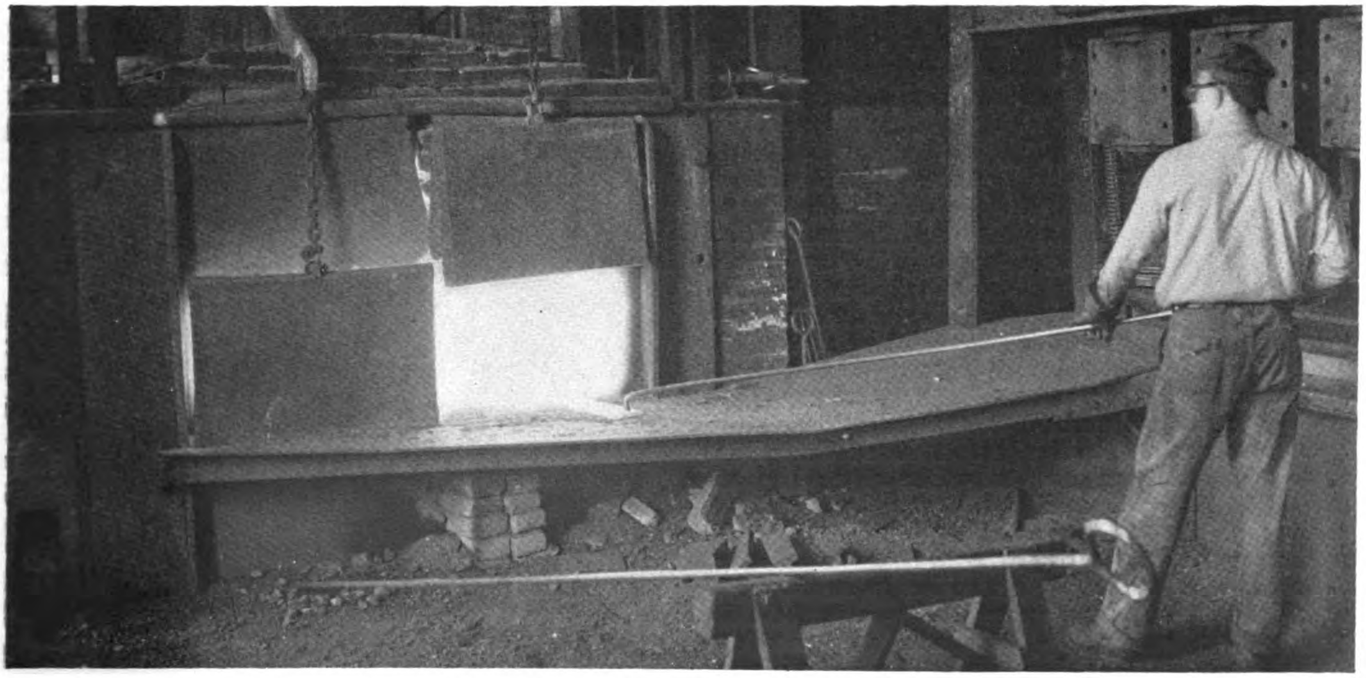


Oil annealing and straightening furnace

committee, which uses this information as guidance in checking more closely the changes, if any, in the supply, although they make regular checks and analyses of all water supplied, both raw and treated, each week, at the division water laboratories, which are in charge of a competent chemist, who controls the amount of change, if the need for it is indicated.

At the present time, water-testing laboratories are in use at every division point on the railroad where locomotive crews are changed, and at the end of each division (approximately 125 miles) a sample of the boiler water is taken from the bottom gage cock, whether the locomotive is relieved from service or continues on over another division. A copper bucket is used to draw samples from boilers, water being drawn off through a rubber hose connected to the bottom gage cock, and the bucket is thoroughly cleaned and rinsed with water from the boiler which is to be tested. After water is drawn, a closely fitting lid is applied to bucket and the sample is taken to the water laboratory for filtering and testing to ascertain the total dissolved content in the water in that boiler and a record is made of the locomotive number, date, name of engineer, point from which locomotive was dispatched, point to which locomotive is being forwarded, if continuing on the run and number of train locomotive is handling. Locomotives are not allowed to depart from a terminal with more than 100 grains T.D.S. per gal., and if any terminal blowing is necessary to attain this figure, the amount of such blowing is recorded by the employee doing this work, this person also indicating the T.D.S. on arrival. Record is made in a book each time a test is made covering each 24-hour period, and a copy thereof is sent to the water committee, superintendent, traveling engineer, master mechanic and general foreman, and a copy is posted in the engineman's bulletin board.

Locomotives used on through passenger trains, where crews change and departure is made before water can be tested are checked against this report to see that each engineer is blowing the boiler according to instructions, such blowing being sufficient to take care of build-up of foaming salts. These instructions cover all classes of service and specify how long to hold each blow-off cock open at intervals of a certain number of miles, this varying according to the nature of the water in any specific district.

Locomotives used in switching service are blown at intervals of a certain number of minutes, or hours, as found necessary by repeated tests made by men under the direction of members of the water committee.

All of the above changes in practice proved so beneficial to fireboxes and boilers that their condition in general has been immeasurably improved and staybolt breakage reduced 75 per cent, even though locomotives have been forced to maintain a higher efficiency than in previous years, due to increased schedules, etc.

The improvement has required the expenditure of a large sum of money, but this has been offset and a very material saving effected through the reduction in the cost of water used, coal used in firing-up cold boilers blown down for water change or washout or to make firebox repairs, as well as the increase in the life of firebox sheets and flues, and the value of having locomotives in service instead of the shop for repairs to say nothing of the satisfaction of operating boilers in good condition instead of having failures or delays en route due to leaks causing locomotives to steam poorly.

Before these practices were put into effect, the life of flues was from 18 to 30 months, with few locomotives operating a full four years without the removal of flues. All flues are now giving four years of service, with a large number of them operating a fifth year on extensions granted by the Interstate Commerce Commission. In several cases, after being operated this fifth year, we have been granted a second extension, giving us six years on flues. The life of our firebox sheets has been increased in the same proportion as the life of the flues.

Report by H. M. Cooper

Our road has made great improvements in the prevention of cracking of firebox sheets out of staybolt holes in the past 10 to 15 years, while no doubt a great deal can still be accomplished.

There are numerous causes for cracks developing in firebox sheets from the staybolt holes—among them, poor workmanship, faulty material, bad water conditions, expansion and contraction. Through any of these causes, staybolts in firebox sheets may start leaking. Bolts that are redriven and worked over to prevent the constant leaking of staybolts causes deterioration of threads in sheet and on the staybolts, and the working over of staybolts sets up strains in the sheet, coupled with expansion and contraction, leads to crystalized sheets and cracks.

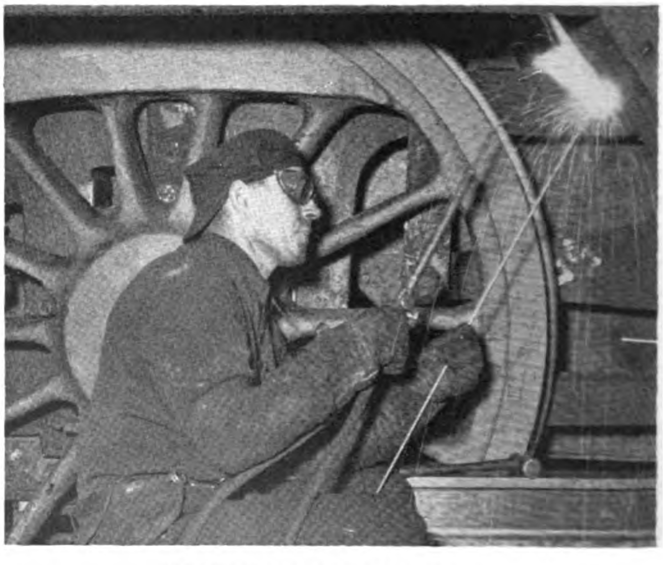
A great amount of success depends on the application of staybolts; small holes should be punched in firebox sheets and patches, and then reamed to the desired size for tapping; they should not be punched over 3/4 in.

Care should be taken to provide good threads in the sheet and on the staybolts; also the bolts should have a snug fit in the sheet and should be cut off to a minimum size head for driving. Bolts should be upset back in the holes as far as possible.

It is a well-known fact that in previous years, before we had treated water, that extensive trouble was experienced with cracks in firebox sheets out of staybolt holes—in fact, far in excess of the trouble that is experienced at the present time. For example, on the power on our railroad, 12 to 14 years ago, it was necessary to renew side sheets on certain classes of power after from 12 to 24 months' service, and the life of the fireboxes was only from 4 to 6 years. At the present time we are getting from 12 to 15 years out of fireboxes, and 4 to 6 years on half and full side sheets; this depends to some extent, on the type of power and the service to which the locomotive is assigned.

With proper water treatment for the district in which

* * *



Welding Seams in an ashpan hopper

the locomotive is operating, we feel that it does not matter whether the staybolt holes are flanged, or whether rigid or flexible staybolts are used. With proper water treatment the desired results will be obtained from any good mechanical application.

It has been our experience that the following of the above practices in firebox applications, and close checking of water treatment for the various districts, and the keeping of boilers and firebox water spaces clean, together with the regular washing and blowing of boilers, have been our major contributing factors in the elimination of the cracking of sheets from staybolt holes.

Discussion

E. J. Brennan, general boiler foreman, Boston & Maine, said that the principal cause for cracking around staybolt holes is due to expansion and that this condition may be relieved by the use of corrugated side sheets of the proper design as evidenced by the experience with several Boston & Maine locomotive boilers which have been in service six to seven years without the development of cracks which formerly showed up inside of 24 months with straight side sheets.

J. A. Doernberger, master boiler maker, Norfolk & Western, cited several failures of corrugated side sheets and said that in his opinion it would be worth while to try counter-sinking the side sheets 1/8 in. around each staybolt hole and applying a welded bead. He said that I.C.C. prejudice against this practice on the score that it defeats the hammer or vibrating tests may be overcome by installing hollow staybolts.

K. E. Fogerty, general boiler inspector, Chicago, Burlington & Quincy, said that relief from the cracking of side sheets at staybolt holes can be secured by the application of air deflector shields just inside the firebox which prevent the cold air from cooling the lower side sheets as it enters the firebox and thus setting up expansion and contraction stresses.

Still another suggestion advanced by F. Yochem, general boiler inspector, Missouri Pacific, was that the removal of the boiler check from the side of the locomotive and locating it at the top center line of the first course proves beneficial in avoiding the introduction of relatively cool water to the bottom of the boiler including the firebox water legs and thus causing unequal expansion stresses.

Fabrication of All-Welded Locomotive Boilers

Committee report on autogenous welding and cutting—D. & H. all-welded boiler discussed

When boiler and pressure-vessel codes officially recognized autogenous welding and cutting for pressure vessels, such recognition was given only after dependable testing equipment was available and welding engineers had determined its basic principles, with the help of the various association committees. Code recognization was supplemented by standard shop tests of practices and material. Manufacturers and shops were required to keep a close check and record on their operators in order that uniformity of work was maintained. The purpose of the codes was to place responsibility on the manufacturer or operating officer, and to remove all questions of all welding engineering from the hands of the operator. Code recognition of welding and cutting has given it a definite standing and with a general improvement in engineering, autogenous process for fabrication and repairs is decidedly on the increase.

Progress in autogenous welding and cutting during the past year has been marked by many notable introductions of new applications, methods and apparatus. One of the principal factors working to increase the use of autogenous welding and cutting in recent years has been the widespread modernization of metals and equipments; this in turn with the progress in welding and cutting made it possible for welded seams and cut edges to be smooth enough for many purposes without further finishing. Furthermore, welding and cutting meet the three following factors of industrial and railroad design: Appearance, cost and durability.

Today's demand is for better products and equipment, straight lines and stream lines. Neatness, beauty and graceful lines, apparent everywhere, are facilitated by the autogenous welding and cutting process. This process is largely responsible for lighter-weight equipment. Greater strength is obtained even where very thin sections are used.

One of the most notable developments in recent years, from the railroad standpoint of fabrication, was an all-welded locomotive boiler. Because of the lack of necessary equipment in the railroad shop for doing this type of welding, as required by the Code of the American Society of Mechanical Engineers for power boilers, little interest was shown for this type of work up to about two years ago. It is only within the last few years that railroad management has shown any great interest in welded construction or any definite desire for an all-welded locomotive boiler. Because of this situation, the Bureau of Locomotive Inspection, has given no indication that welded boilers could be operated in interstate commerce. In fact, they have been opposed to the extension of welded construction for boilers and have not sanctioned its use.

From the railroad's point of view, this condition has now changed and great interest has been indicated. It is realized that worthwhile saving in weight and a smoother boiler contour can be secured by the use of the all-welded locomotive boiler. This change in sentiment was recognized by the Interstate Commerce Commission and they agreed to the construction and operation of an experimental all-welded locomotive boiler, the design having first been reviewed and approved by the General Committee on Locomotive Design of the Association of American Railroads.

The Delaware & Hudson All-Welded Boiler

This permission to build an all-welded locomotive boiler was granted to the Delaware & Hudson under the provision that it would be tested in actual operation for six weeks as a stationary unit before it was permitted to operate in road service.

The barrel portion of this boiler is conical in shape, 88 in. outside diameter at the smokebox end, and 94 in. outside diameter at the firebox end; the plate thickness is 1 1/16 in., providing a factor of safety of 5 for a working pressure of 225 lb. per sq. in. with an allowable joint efficiency of 90 per cent. The firebox inside is 132 in.

long by 114 in. wide, measured at the grate. The outside firebox wrapper sheet is ⅝ in. thick. The longitudinal and circumferential seams of the boiler shell up to the smokebox are double welded butt seams meeting all of the requirements of Section I of the A.S.M.E. Boiler Code for welded power-boiler shells and drums. The dome is 33 in. inside diameter, flanged from one piece of plate 1$\frac{1}{16}$ in. thick; the bottom flange is fitted into the shell and attached with a double-welded butt weld. The boiler shell is reinforced at this point by a flanged dome liner 1⅛ in. thick, which extends up into the dome, being attached to the dome and boiler shell by fillet welds at the edges of the liner. The throat sheet and top connection between the shell and firebox wrapper sheet is integral, having been formed from a plate 1$\frac{3}{16}$ in. thick. The backhead is $\frac{9}{16}$ in. thick of normal design, except that the flange is made sufficiently deep to permit the location of the welded joint between two rows of staybolts.

The injector check flanges, all washout plug bushings, flexible staybolt sleeves, angle attachments, and all bosses that are tapped for other attachments, to the boiler have been welded to the shell by fillet welds. The front tube sheet is welded to a circular ring which is fitted to the inside of the shell and attached by fillet welds. The ring is provided with slots at the top and bottom centers so that the tube plate can be removed and renewed without cutting out any welds except those directly attaching the tube sheet to the circular ring.

The boiler has a cast-steel firebox ring of a special cross section with flanges on the top side permitting the attachment of the ring to the firebox sheets by the bottom row of staybolts; thus, the fillet welds between the sheets and the ring are for tightness only, the ring being supported by other means. The firedoor hole is formed in the usual manner by flanging the backhead sheet inward and the firebox-door sheet outward, neatly butting these flanged edges and joining them by a single welded butt weld. All of the welds in the boiler shell, including those in the outside sheets of the back end were stress relieved in accordance with the A.S.M.E. Code requirements for power boilers.

In stress relieving this boiler shell the furnace temperature was brought up slowly to 1150 deg. F., held at that temperature for 2¼ hrs., and then allowed to cool slowly. Before the boiler shell was placed in the furnace, the firebox ring was bolted in place as a stiffening member and the flat and circular parts of the wrapper sheet were thoroughly braced to prevent distortion. The stress relieving was accomplished without any change in contour. The firebox was then applied, staybolts and tubes inserted and the boiler completed without any re-shaping being required.

The steel used in the fabrication of this boiler was to be A.S.M.E. Material Specification No. S-1, 55,000 lb. minimum tensile strength, but a special low-carbon steel was finally substituted after several tests of steel had been made, as extreme care was exercised in the selection of the material. In making tests of this latter steel, tensile-test pieces broke through the parent metal at approximately 60,000 lb. per sq. in.

The all-weld metal specimen showed a yield point of more than 50,000 lb. per sq. in., and an ultimate strength of more than 60,000 lb. per sq. in. Elongation was 30 per cent. The free-bend specimen showed an elongation in the weld metal of 30 per cent.

The bracing and staying of the backhead and front tube sheet are of the usual type for locomotive boilers. The bracing tees are riveted to the flat portions of the heads, the crow feet are riveted to the shell, and the brace rods are of the weldless type with pin connections. The tubes are applied in the normal manner and seal welded for tightness at the firebox end.

The boiler was given a hydrostatic test at twice the working pressure after the welds had been hammer tested under hydrostatic pressure at 150 per cent the working pressure.

After completion and acceptance the boiler will be installed on one of the existing Delaware & Hudson Class E-6-A locomotives, and after a stationary test period of six weeks, it will be placed in regular road service.

The performance of this boiler will be carefully followed, careful measurements will be taken from time to time and frequent inspections made to secure a complete service record.

Pending the results of these tests, the Interstate Commerce Commission will not authorize the construction or operation of any additional all-welded boilers for locomotive service and its prohibition against autogenous welding in making locomotive boiler repairs by railroads in their own shops still remains in effect as heretofore.

Welded Tender Tanks

Still another important factor in autogenous welding and cutting is the fabrication of locomotive tender tanks. These tanks are being fabricated by the autogenous welding process, preferably with the electric-arc process, in an ever increasing quantity and satisfactory methods have been gradually developed. The welding, because of the relatively thin sheets and great area of flat surface, cannot and need not be stress relieved. The tees or angles employed as stiffeners and to attach swash plates are welded with intermittent fillet welds. The welds in the outside sheets are continuous single-welded butt welds to present a smooth surface. As far as possible this welding is done in a down position.

Swash plates and bulkheads are completely fabricated ready for attachment by welding in their proper positions in the tank so that the down-position welding can be arranged for with a minimum of handling, and also to permit the major portion of the welding to be done in the open, thus leaving very little to be performed inside the tank after it becomes a partially closed structure. These fillet welds are usually either a single-pass or double-pass weld, and the use of suitable covered electrodes makes possible the production of strong welds.

Discussion

In discussion of the report the chairman of the committee appointed by the International Acetylene Association to co-operate with the Master Boiler Makers' Association submitted an illustrated talk on the effect of flame cutting upon steel boiler plate. He explained that of the items submitted in a report by his committee to this association last year, he had found that the question of the effect of flame cutting upon boiler plate, either when severing a section of plate or in removing rivets and staybolts, had proven of the greatest interest. Furthermore, he had learned that test data upon individual samples of new boiler plate as reported at the convention last year, did not impress the association as much as would have been the case if the cutting had been applied to plate actually in use in locomotive boilers.

As a result, the I. A. A. committee undertook to obtain the experimental data that seemed to be desired. Through the courtesy of A. F. Stiglmeier, a number of samples of wrapper sheet were obtained from a scrapped locomotive boiler, with the staybolts attached thereto, the fire box sheets having been cut away. The effort was made to determine, by all sorts of physical tests, the effect of flame cutting for removal of the staybolts

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as compared with the original physical properties of the boiler plate.

Much ingenuity was required to determine the types of tests that would be the most effective indicators of the resulting conditions. The committee reasoned that if the ductility of the plate material were retained after the heating effect of the flame cutting operation and no excessive change occurred in the grain structure of the steel to cause hardness or brittleness, there probably could be no reasonable question about the retention of the original physical qualities of the plate.

In order to accomplish this, it was decided to subject specimens taken from the samples of wrapper sheet to microscopic examination and tests to learn all that was possible to know about the resulting physical qualities.

Method of Making Tests

In carrying out these tests, samples were first tested without removal of the staybolts; then the staybolts were removed by the customary flame cutting operation and specimens taken out in such a manner as to test the material adjacent to the staybolt holes. The tests were carried out in such a way as to determine the ultimate tensile strength, the yield point, the elongation under tensile test, the elongation in free bending and the hardness as determined by the Rockwell "B" test; in addition plate sections were examined microscopically to give the additional check of effect upon grain structure in the heat affected zones.

The report tended to indicate that there was little difference in the physical properties of the sections taken from the wrapper sheet before and after the staybolts had been removed. Comparative figures indicated that while the specimens from which the staybolts had been removed by flame cutting showed a very slight increase in hardness adjacent to the hole after the staybolt had been removed, this difference amounted to only about ten (10) points on the Rockwell "B" scale. Coupled with this, however, was the very interesting fact that in the case of a wrapper sheet specimen in which the staybolt had been removed by drilling and no heating applied at all, the Rockwell "B" hardness test showed about five (5) points greater hardness adjacent to the threaded hole as compared with the surrounding area at a distance of an inch or more away from the hole.

Tests Show No Injurious Effect from Heating

The report showed that the tension tests and the bending of the wrapper sheet specimens from which the staybolts had been removed gave results that were not exactly comparable as those applied to the plate with the staybolt in place, because of the marked deformation of the plate adjacent to the staybolt hole. The result was, generally, a slightly increased tensile strength and a lowered ductility. In order to reduce this tendency toward deformation, another set of specimens was run through the same series in which threaded plugs were screwed into the threaded openings in the wrapper sheet specimens after the staybolts had been removed by flame cutting. These threaded plugs were made to fit quite tightly so as to restrain the hole from deforming. With the threaded plugs in place, the results obtained were much more exactly comparable with those on the wrapper sheet samples with the staybolts left in place. This tended to again establish the freedom of injurious effect from the heating due to the flame cutting operation.

In the explorations of the plate samples by microscopic studies, it was found that in no case where the staybolt head had been removed by flame cutting without injury to the threads, was there any appreciable change in the grain structure of the wrapper sheet adjoining the hole. Numerous micro-photographs were submitted to prove this. In other cases, where the flame had been deliberately caused to contact with threads in the wrapper sheet, it was shown that there was a noticeable change in the grain structure to a depth of about $1/16$ inch. Hardness explorations in this zone indicated, however, that the increase in hardness was only about 15 points which amounted really to a very slight change in the physical properties; it is not likely that a change as slight as this would have any material effect upon physical properties of the plate.

A supplement to the committee report embraced comparative tests of samples of ordinary fire box steel plate and the so-called 2 per cent nickel alloy boiler plate. These samples had been submitted to the committee by Mr. Stiglmeier in the thought that with the increasing use of nickel alloy plate in locomotive boilers it might be interesting to know the effect of flame cutting on the latter. Both physical test results and microscopic studies of the results of this investigation were submitted. These results tended to indicate that for the type of nickel alloy plate tested no appreciable difference could be expected between them as far as their strength and mechanical manipulation is concerned.

Three other prepared discussions were presented in connection with this report. These were: Arc Welding for Code Requirements, by H. S. Card, development director, National Electric Manufacturers Association, Electric Welding Division; What Development of Coated Electrodes Has Done for the Railroads, by J. A. Coakley, Jr., Lincoln Electric Sales Company, and Heat Effect in Welding, by Dr. W. G. Theisinger, welding and metallurgical engineer, Lukens Steel Company. Parts of these papers will appear in later issues.

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NEWS

The Mechanical Exhibit at Chicago

All available space utilized for instructive and educational purposes

THE Allied Railway Supply Association made a really remarkable record in the exhibit which it provided for the mechanical conventions that met at Chicago, September 28-October 1. There were 107 exhibitors, taking up all of the available space in the Exhibit Hall and on the mezzanine floor of the Hotel Sherman.

OFFICERS ELECTED

At a meeting of the Allied Railway Supply Association on Thursday, October 29, the following officers were elected for the coming year: President, L. B. Rhodes, Vapor Car Heating Company, Washington, D. C.; first vice-president, J. W. Fogg, MacLean-Fogg Nut Company, Chicago; second vice-president, C. F. Weil, American Brake Shoe & Foundry Company, Chicago; third vice-president, F. W. Venton, Crane Company, Chicago; fourth vice-president, M. K. Tate, Lima Locomotive Works, Inc., Lima, Ohio; fifth vice-president, H. S. Mann, Standard Stoker Company, Inc., Chicago, and sixth vice-president, R. T. Peabody, Air Reduction Sales Company. J. E. Gettrust, Ashton Valve Company, Chicago, and G. R. Boyce, A. M. Castle & Co., Chicago, were re-elected secretary and treasurer, respectively.

In the story on the Allied Railway Supply exhibit in the *Railway Mechanical Engineer* for September, page 398, we overlooked including the names of the members of the Exhibit Committee. This is unfortunate, because this particular committee performed an outstanding task. Its members were J. E. Buckingham, Lincoln Electric Company, (Chairman); W. Leopold, Worthington Pump & Machinery Corporation; W. T. Lane, Franklin Railway Supply Company and J. F. Franey, Pilot Packing Company, Inc.

In addition to the exhibitors who were listed in our September number, page 401, the following additions and revisions should be made:

ADDITIONS AND REVISIONS TO LIST OF EXHIBITORS

AIR REDUCTION SALES COMPANY, New York.—Airco oxygen and acetylene; National carbide; Airco-DB welding and cutting apparatus and supplies; Wilson electric arc welding machine. Represented by C. B. Armstrong, A. W. Brown, J. T. Gillespie, C. Holt, J. W. Kenefic and R. T. Peabody. Spaces 224, 225 and 226.

APEX RAILWAY PRODUCTS COMPANY, Chicago.—Dust guard; defect card holder; Trilock safety steel; running boards; brake step. Spaces 195 and 196.

BALDWIN LOCOMOTIVE WORKS, THE, Philadelphia, Pa.—Non-exhibitor.

BUCKEYE STEEL CASTINGS COMPANY, THE, Columbus, Ohio.—Models of Buckeye six-wheel tender truck; four-wheel spring plankless, double truss truck; A.A.R. alternate standard swivel yoke assembly; A.A.R. standard E coupler; A.A.R. standard vertical plane yoke. Represented by F. J. Cooledge, M. R. Hansen, W. W. Matchneer, H. A. Moeller and George Sutherland. Spaces 209 and 210.

CARDWELL CORPORATION, THE, Peoria, Ill.—Cardwell spring truck; Cardwell journal brass remover. Represented by Thomas Cardwell. Space 247.

CASTLE & COMPANY, A. M., Chicago.—Special stools. Represented by O. F. Olson. Space 193.

CHICAGO EYE SHIELD COMPANY, Chicago.—Head and eye protection equipment. Represented by Joseph Duffy. Space 207.

CHICAGO PNEUMATIC TOOL COMPANY, Chicago.—Non-exhibitor.

COFFIN, JR., COMPANY, THE J. S., Englewood, N. J.—Coffin feedwater heater system, showing recent improvements in design and application; locomotive Superdraft. Represented by T. C. Browne, William Christiansen, W. T. Comley and Paul Willis. Space D.

GORHAM TOOL COMPANY, Detroit, Mich.—Complete set of contour tire turning tools; heavy duty insert turning tools; heavy duty insert boring tools; inserted blade cutters; helical milling cutters, shank and arbor type. Represented by H. B. Johnson and T. A. Oleck. Space 208.

HOLLUP CORPORATION, Chicago.—Welding electrodes, supplies and applications. Represented by R. C. Bender, O. L. Howland, G. O. Rohder and H. F. Ziegler. Space 148.

LOCOMOTIVE FINISHED MATERIAL COMPANY, The, Atchison, Kan.—Z-type light-weight, high-tensile alloy steel piston and cross-section of same; Universal sectional bull and packing ring made of cast iron and alloy bronze; model, one-piece cast steel locomotive cylinder; model, disk type locomotive driving wheel center. Represented by R. L. McIntosh, A. H. Moorhead, G. W. Taylor and John Welch. Spaces 211 and 212.

MURCOTT & CAMPBELL, Brooklyn, N. Y.—Files. Represented by Harry W. Leighton. Space 187.

NATIONAL TUBE COMPANY, Pittsburgh, Pa.—National boiler tubes and superheater tubes; National seamless pipe; National scale free pipe; National copper-steel pipe; National seamless mechanical tubing. Represented by J. W. Kelly, I. J. Pool, J. S. Raymond and Y. P. Yochem. Spaces 198, 199 and 200.

PILLOID COMPANY, THE, New York.—Redesigned Baker valve gear equipped with Multirol precision bearings; McGill Multirol precision bearings. Represented by L. R. Baker, Frank Fisher and R. H. Weatherly. Spaces 36, 37, 52 and 53.

RYERSON & SON, INC., JOSEPH T., Chicago.—Lewis staybolt iron; Ryerson certified alloy steel plan. Represented by J. P. Moses, A. M. Mueller and G. L. Shinkle. Space 107.

SCULLY-JONES & COMPANY, Chicago.—Boiler tools, including expanders; tube setters, flue cutters, beading tools, rivet sets, screw punches, drill sleeves, tap holders, etc. Represented by R. W. Besant and C. O. Watkins. Space 149.

SELLERS & COMPANY, INC., WILLIAM, Philadelphia, Pa.—Type "S" injector. Represented by T. H. Jessop, John D. McClintock, P. E. Raymond and Alexander Sellers, Jr. Space 197.

SPRING PACKING CORPORATION, Chicago.—Spring journal box packing; bagged Spring packing; Spring-lox for holding packing in place. Represented by William Gibbs. Space 206.

SUNBEAM ELECTRIC MANUFACTURING COMPANY, Evansville, Ind.—Locomotive headlights and turbo-generators. Represented by C. E. Kinnaw, W. E. Richard and J. Henry Schroeder. Spaces 163, 164 and 165.

THRESHER VARNISH COMPANY, THE, Dayton, Ohio.—Literature. Represented by J. C. Drummond. Space 203.

UNITED STATES STEEL CORPORATION, Pittsburgh, Pa.—See National Tube Company.

WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J.—Locomotive feedwater heater; literature and equipment. Represented by S. L. Brownlee, J. F. Cosgrove, T. Cruthers, W. R. Leopold, T. C. McBride, J. W. Rafferty and T. C. Wentworth. Space 68.

YALE & TOWNE MANUFACTURING COMPANY, THE, Philadelphia Division, Philadelphia, Pa.—Yale electric industrial trucks; hand lift trucks; hoisting equipment. Represented by George C. Isbester, M. G. Peck, S. W. Gibb, J. R. Harlan and H. A. White. Spaces 142 and 143.

Baldwin Publishes Survey of Motive Power Needs

THE Baldwin Locomotive Works has recently issued a 76-page study entitled "The Motive Power Situation of American Railroads," which, on the basis of statistics compiled largely by the Federal Co-ordinator of Transportation and the Interstate Commerce Commission, establishes the contention that the purchase of new motive power, as opposed to rehabilitation of existing rolling stock, is essential to the continued health of the American carriers. Upon a groundwork of history of rail traffic since 1900 and a presentation of

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New Equipment Orders and Inquiries Announced Since the Closing of the September Issue

LOCOMOTIVE ORDERS

Company	No. of locos.	Type of loco.	Builder
Lehigh Valley	2*	600-hp. Diesel-elec.	Electro-Motive
	2†	900-hp. Diesel-elec.	Electro-Motive
	2‡	900-hp. Diesel-elec.	Electro-Motive
B. & O.	1	16-cylinder steam	Company shops
M., St. P. & S. S. M.	1	Snow plow	Russell Snow Plow Co.
Pennsylvania	1	600-hp. Diesel-elec.	Electro-Motive

LOCOMOTIVE INQUIRIES

Westinghouse Air Brake	1	0-4-0 switching	....

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
General Chemical Co.	90	Tank	American Trans. Corp.
M., St. P. & S. S. M.	100	40-ft. 50-ton steel box	Pullman-Standard
U. S. Navy Dept.	2	Flat	Haffner-Thrall Car Co.

PASSENGER-CAR INQUIRIES

Road	No. of cars	Type of car	Builder
A. T. & S. F.	17	Coach	....
	20	Baggage	....
Pennsylvania	6	Coach	....
	4	Passenger-baggage	....
	4	Baggage-mail	....
	5	Dining	....

* Are now in service.
† Will be placed in service about Jan. 1, 1938.
‡ Will be placed in service about May 1, 1938.

present-day locomotive inventories, the study concludes that about 94.4 per cent of all motive power measured numerically and 91.2 per cent by tractive power is "more or less obsolete."

Stepping to its second chief topic, the cost of locomotive maintenance and operation, the study points to statistics and conclusions published in reports of the Federal Co-ordinator of Transportation defining the economic life of a locomotive and purporting to prove that increased maintenance costs do not warrant the continued use of motive power beyond these defined limits. Further statistics point to the advantages of the speed, economy, and power of the modern locomotive, with emphasis on the necessity of an adequate locomotive replacement program and the importance of writing adequate depreciation charges in capital accounts.

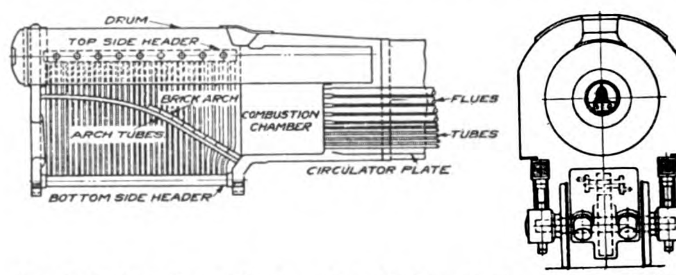
Further quotations support the contention that, although due credit must be given to the virtue of Diesel power, the steam locomotive must "continue to be the mainstay of railroad operation for the indefinite future." Complete tables and graphs supporting the thesis follow.

5,000 hp. and be capable of speeds of 100 m.p.h. on straight level track with a train of 14 standard Pullman cars. The locomotive will have a tender mounted on two six-wheel trucks with a coal capacity of 23 tons and a water capacity of 22,000 gallons.

The arrangement of the four Besler steam motors gives a total of 16 cylinders with 32 impulses to each revolution of the steam motors. With this design no counter balancing will be required, and, inasmuch as there are no main and side rods or crankpins, hammer blows on the track

gear together with reversing mechanism will be automatically regulated from the cab by means of electro-pneumatic control.

The total weight of the locomotive will be about 400,000 lb., 260,000 lb. of which will be on drivers. The total weight of the tender will be 350,000 lb. The tractive force at starting will be 72,500 lb., giving a factor of adhesive of 3.6 which is more than ample with the uniform torque. The Besler steam motors have a bore and stroke of 9½ in. by 7 in., and the gear ratio between the steam motors and the



Longitudinal section of firebox and combustion chamber and (at right) the cross section showing the arrangement of steam motors

B. & O. 16-Cylinder Steam Locomotive

Designs have recently been completed by the B. & O. for a 4-8-4 type steam locomotive which will be powered by Besler steam motors. Each of the four driving axles will be driven by a four-cylinder steam motor geared to the axle. It is estimated that this locomotive will develop

will be eliminated. The absence of main and side rods and other motion work will also make it possible for the driving wheels, with their independently mounted steam motors, to negotiate sharper curves than locomotives of conventional design.

Gears and all other moving parts of the steam motor will operate continuously in a bath of oil forced by a pump to wearing parts. The cutoff position of the valve

axle is 19 to 55. The total driving wheelbase is 21 ft., and the total engine wheelbase is 46 ft. 7¾ in. The total engine and tender wheelbase is 103 ft. 3¼ in., and the length overall is 115 ft. 7¾ in.

The locomotive will be equipped with an Emerson water-tube firebox boiler having 775 sq. ft. of heating surface in the firebox and a total heating surface of

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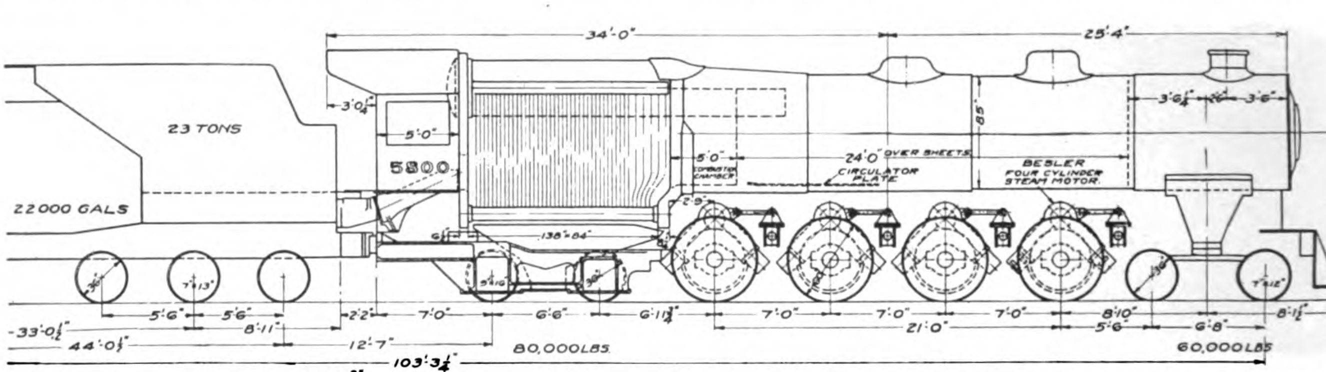
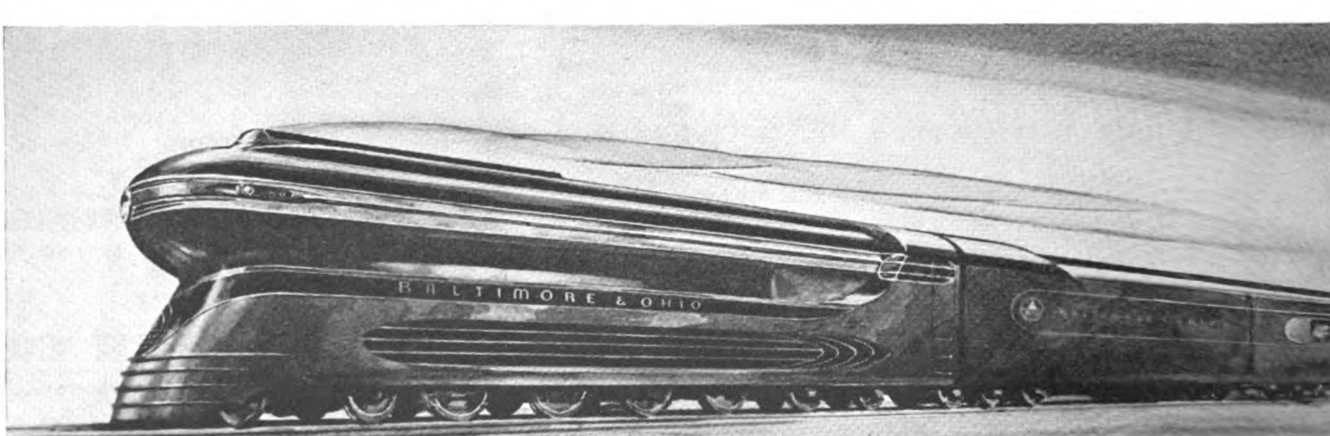


Elevation of B. & O. 16-cylinder, 5,000 hp. steam locomotive



Artist's conception of the proposed B. & O. locomotive powered by four four-cylinder steam motors

Factors that BETTER Locomotive Performance

HIGH DEGREES OF SUPERHEAT - The accompanying tabulation shows the increase in locomotive efficiency as the degree of superheat increases. Type "E" superheaters provide the higher degrees of superheat. The Improved Type "E" superheater design has greatly reduced maintenance cost by extending the return bends and bifurcates further ahead of the front tubesheet and away from the travel of furnace gases and flying cinders.

Steam Temperature	*Steam per I.HP.HR.*	*Saving in Steam From the Use of Superheat*
Saturated Steam	28 lb.	—
150° Superheat	21 lb.	25.0%
200° "	18 lb.	35.6%
250° "	16 lb.	43.0%
350° "	14 lb.	50.0%

DRY STEAM FROM THE BOILER - For each 1% of moisture that is carried over into the superheater with the steam, there is a drop of about 17 degrees in superheat. The Elesco tangential steam dryer effectively separates moisture from the steam and will handle as much as 20% of moisture in the steam at an efficiency of better than 80%. The steam inlet is located at the highest point in the dome and is unobstructed and non-cloggable. It is easy to install, has no moving parts, and has a minimum pressure drop.

FEED WATER HEATING BY EXHAUST STEAM - The application of Elesco feed water heating equipment to your locomotives, of either the single stage injector type, or the closed type equipped with one pump, will substantially increase the evaporative capacity of your boiler. Both types are dependable and have been widely applied to locomotives throughout the world; each type satisfying certain conditions or preferences. Both types use waste exhaust steam, which results in a fuel saving of 8%—15% or a corresponding increase in horsepower. The operation of the Improved Elesco exhaust steam injector is both stable and efficient with feed water temperatures up to 105 deg. F. and boiler pressures up to 300 lb.

A QUICK AND SMOOTH ACTING THROTTLE - Locomotives today require a quick and smooth acting throttle. The American multiple-valve throttle, located in the front end, provides an instant and smooth control over the movements of the locomotive. As it is built within the superheater header, there is an economy of flanged steam joints and weight, and space. The small valves do not warp and assure a tight throttle. The great majority of new locomotives are equipped with American multiple-valve throttles.

ELESCO

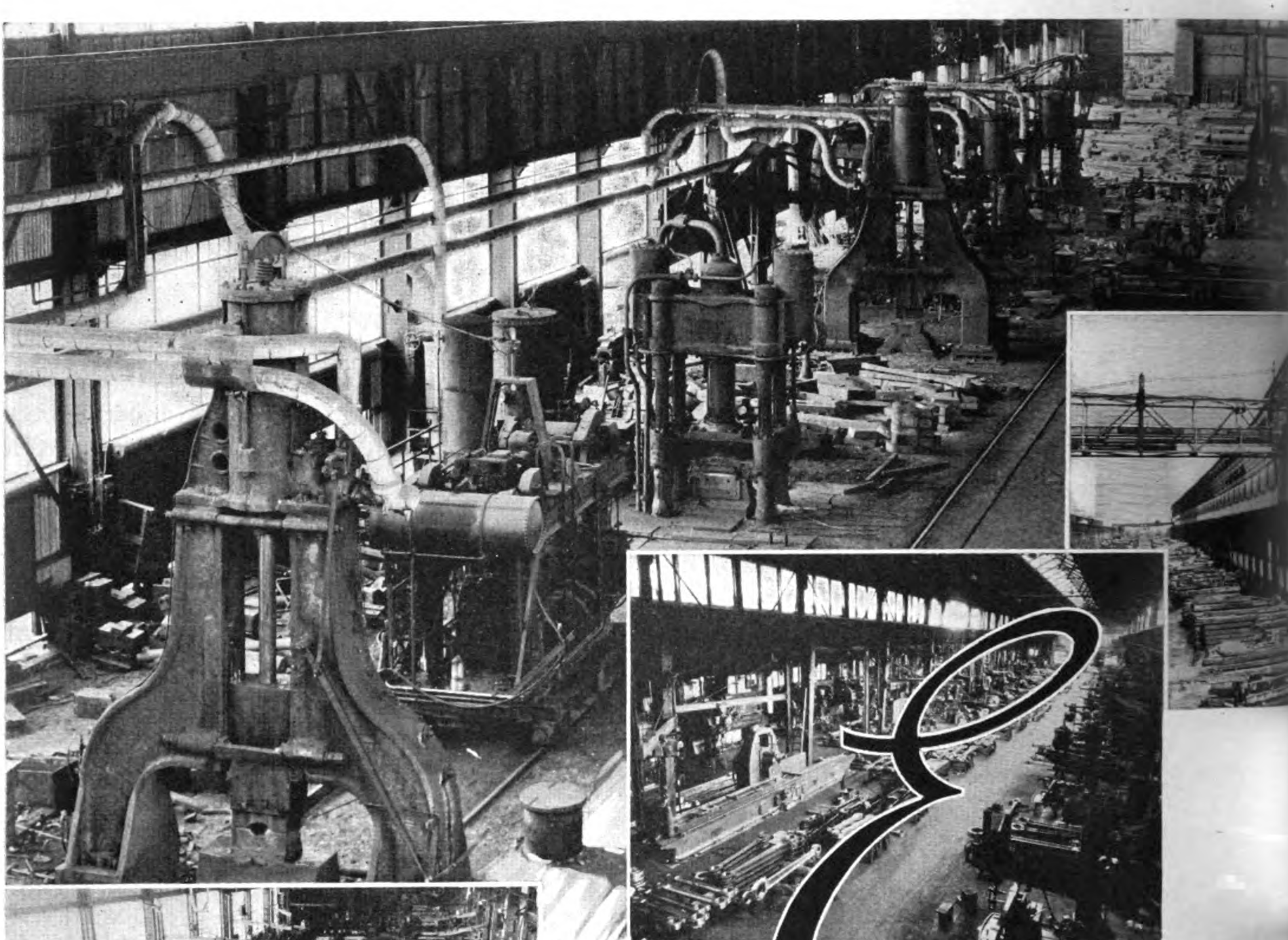
THE SUPERHEATER COMPANY

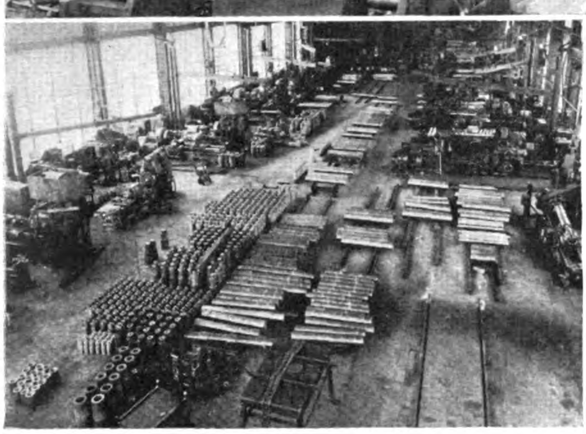
A 1175 Representative of AMERICAN THROTTLE COMPANY, INC.

60 East 42nd Street, NEW YORK Peoples Gas Building, CHICAGO

Canada: THE SUPERHEATER COMPANY, LTD., MONTREAL

Superheaters « Exhaust Steam Injectors « Feed Water Heaters « American Throttles « Pyrometers « Steam Dryers





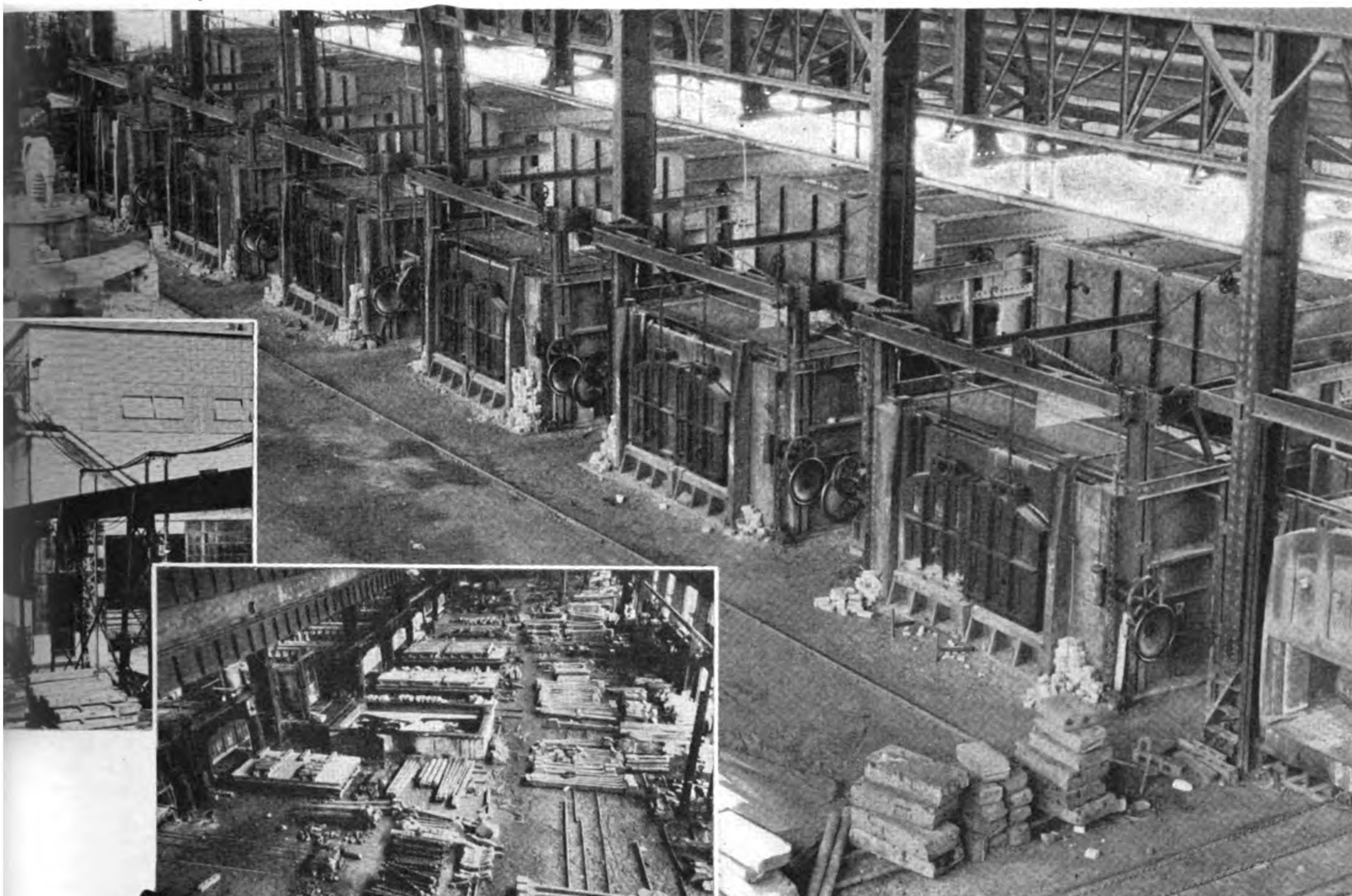
Every

It Takes to Ma
Light-weight All

WITH the advent of higher speeds demanding lighter reciprocating parts, Alco was cognizant of the fact that the facilities heretofore used were entirely inadequate.

Realizing that an entirely different manufacturing set-up including equipment and personnel was imperative, Alco remodeled its entire forging department. Expensive appliances adapted to the working of alloy steel were placed in service—up-to-date forging machinery—scientific testing apparatus—special preheating and heat-treating furnaces—modern temperature control devices—special finishing machinery and many other costly items.

AMERICAN LOCOM
30 CHURCH STRE



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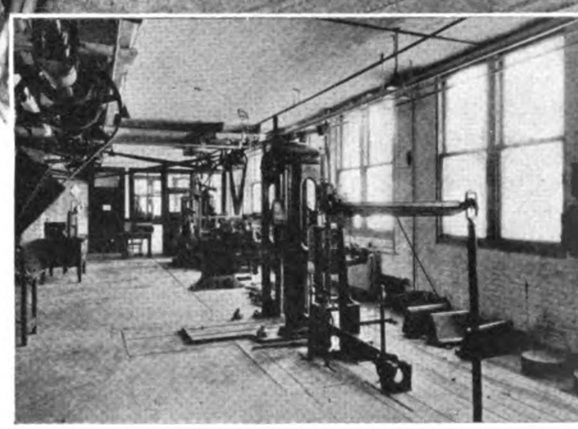


Everything necessary to render the railroads a high-grade service on light-weight forgings.

Estimate the number of alloy steel forgings you are likely to require annually. Then ask yourself if a heavy expenditure for new special equipment comparable to Alco's is justified. Unquestionably you will find that it will be far less expensive to purchase light-weight alloy steel forgings from Alco when all capital charges and other costs are considered.

Made by experts—with the finest of materials fabricated by the most modern facilities —Alco forgings deliver the utmost in economical and dependable transportation.

OTIVE COMPANY

· NEW YORK · N · Y ·

5,800 sq. ft. It will have a superheating surface of 1,530 sq. ft. and will be equipped with a feed-water heater. The firebox will be 138 in. by 84 in. and have a grate area of 80.5 sq. ft. The Besler steam motors operate on a guaranteed rating of 14 lb. per hp., and when the locomotive is developing 5,000 hp. the cylinders will require 70,000 lb. of water per hr., while the boiler will evaporate 80,500 lb. The working pressure is 350 lb. per sq. in.

The new locomotive will be extremely flexible in design and will have outside frames and spring rigging with oil-lubricated outside journal boxes. Each pair of driving wheels with its attached steam motor can be quickly removed on a drop pit for necessary repairs.

The locomotive will be streamlined on a pattern developed for the B. & O. by Otto Kuhler, consulting engineer of design. The design has been used in an adapted form for the streamlining of the B. & O.'s Diesel-electric locomotives and its New York train-connection motor coaches. A President-type B. & O. steam locomotive, streamlined along the lines for the proposed new locomotive, will soon be placed in service.

H. S. Air Brake Shown at N. Y. Science Museum

A COMPLETE train brake system of the electro-pneumatic high-speed type developed for use on fast streamliners has been installed in the New York Museum of Science and Industry, Rockefeller Center, New York, as a further development in the "do it yourself" exhibit.

Visitors who have yearned to run a real train may experience something of a thrill by pushing a lever controlling the exhibit mechanism. The latter controls a miniature train, modelled after the type which uses this type of brake, which, when the controls are set, moves along a scale track. Below this, a working model of the air brake system in nearly full size operates in sequence illustrated by arrows.

A complete diagram of the mechanism of the locomotive unit in a typical Diesel-electric streamliner has also been located in the exhibit.

Big Railroad Exhibit at New York World's Fair

FORMAL contract for the greatest amount of exhibit space and the largest single display at the New York World's Fair 1939 was signed on September 15 by the Eastern Presidents' Conference, composed of the heads of 34 railroads, and Grover Whalen, president of the Fair. The contract calls for the occupancy of 676,888 sq. ft. of space in the Transportation Section, upon which the combined roads will erect a building containing 110,000 sq. ft. of exhibit space. The rental price is $97,438 and the fund set up for the construction of the building and assembly of exhibits amounts to $1,500,000. Within the building, the main entrance of which will carry out the design of a roundhouse, and upon the surrounding terrain, the railroads hope to tell the whole story of railroading in the United States, from the early days of wood-burning locomotives to the streamline, motor-driven trains of today, and also to portray graphically what the traveling public may expect in safety, comfort and speed in the years to come. Provision will be included for track shows and stage spectacles for an audience of 4,000.

C. M. St. P. & P.—Correction

IN THE table of equipment orders and inquiries on page 425 of the September issue an order for 1,000 gondola cars of 70 tons' capacity, placed by the C. M. St. P. & P. in its own shops, was included. This is incorrect in that these cars were included in a previous order for 2,022 cars included in the *Railway Mechanical Engineer* table of equipment orders and inquiries for May, 1936, page 242.

Stokers for Big Locomotives

EXPRESSING the belief that the use of large hand-fired coal-burning steam locomotives in fast and heavy service causes unnecessary peril to the life and limb of travelers and employees on the railroads, Special Examiner Homer C. King of the Interstate Commerce Commission, in a proposed report to the commission, has recommended that it order the railroads of the country to equip approximately 3,500 of their remaining locomotives, used in through service, with automatic stokers. The case arose in 1930 upon the complaint of the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen and was directed against all the railroads of the country, which are subject to the Interstate Commerce Act. Hearings were held in 1931, and were then suspended until 1936, when they were resumed and completed in the early part of 1937, in Washington.

The report states that while the complaint as originally filed included all coal-burning steam locomotives not mechanically fired, the complainants by a statement of record which was entered at almost the end of the hearings, withdrew their request for the installation of stokers on passenger locomotives weighing less than 125,000 lb. on driving wheels, and consuming less than an average of 1,800 lb. of coal per hour; and on freight and yard locomotives weighing less than 150,000 lb. on driving wheels, and consuming the same amount of coal as the passenger locomotives.

In tabulating the returns from a questionnaire which was sent to all the railroads and which involved 47,393 locomotives, the examiner points out that of this number, 8,154 were assigned to passenger service, 6,831 of them using coal as fuel. Of that number, 1,347 were equipped with stokers, the vast majority being used in through service. The average weight on the driving wheels of these locomotives equipped with stokers was 209,000 lb. The questionnaire also showed that all passenger locomotives weighing 250,000 lb. or more were equipped with stokers; of 1,018 weighing between 200,000 lb. and 250,000 lb., 532, or slightly more than 50 per cent, were so equipped; of 1,570 weighing between 170,000 and 200,000 lb., 515, or approximately 33 per cent, were so equipped; and of the 4,064 which weighed less than 170,000 lb., only 125 had stokers.

The questionnaire also discloses the fact that out of the 26,000 freight locomotives, about 21,000 used coal as fuel, and 10,160 were equipped with stokers. The average weight of the stoker equipped freight locomotive was found to be about 280,000 lb.

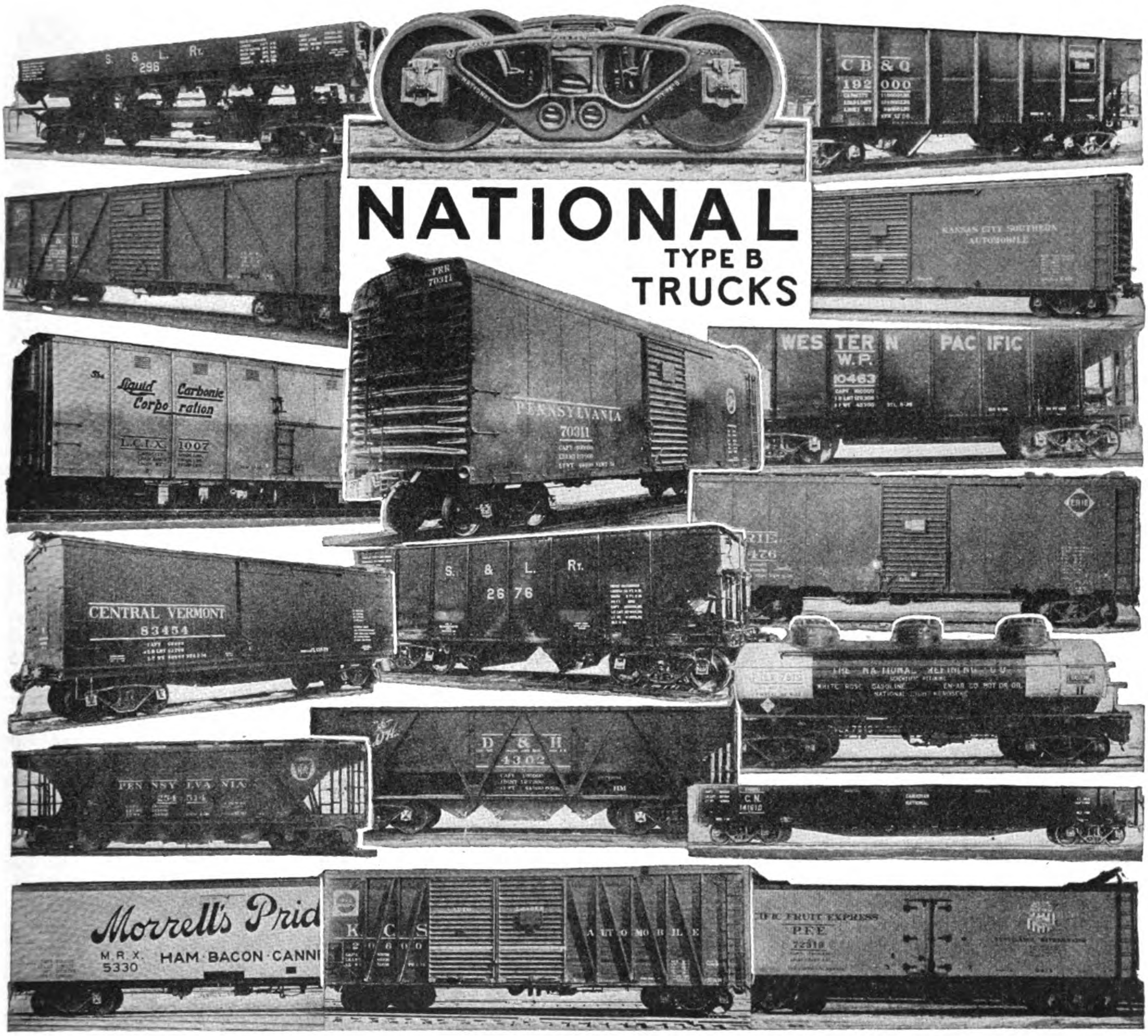
After examining the various types and weights of locomotives used in both freight and passenger service, the examiner comes to the conclusion that all passenger locomotives weighing more than 170,000 lb. and all freight locomotives weighing more than 185,000 lb. should be equipped with automatic stokers. He goes on to say that the weight limits "are, if anything, too high," but he feels that they are "sufficiently high to avoid the possibility of including any locomotives which may be hand fired and operated without unnecessary peril to life or limb."

The final question to be discussed by the proposed report is that of the cost of the application of stokers. The railroads had alleged in their answer to the complaint that the cost of applying stokers to all locomotives would be approximately $115,000,000. The examiner says the record shows that the cost of installing a stoker is around $3,000. The returns from the commission's questionnaire shows that as of February 28 there were not more than 3,500 locomotives on which the application of stokers would be necessary in order to comply with the recommendations of the examiner. He estimates that the total cost of the installation should not be more than $11,000,000. Since the cost of maintenance of the stoker is approximately one cent per mile, the examiner concludes that the application of stokers to the remaining 3,500 locomotives would be an economical move for the carriers in view of the fact that the railroads admit that the stoker provides for more efficient operation of the engine.

Examiner King would have the commission find that in order to prevent unnecessary peril to life or limb, and to promote the safety of employees and travelers upon railroads, no coal-burning steam locomotives built on or after April 1, 1938, which weigh 170,000 lb. or more on driving wheels, shall be used in through passenger service; and that no coal-burning steam locomotives built on or after that date, which weigh 185,000 pounds or more on driving wheels, shall be used in through freight, helper, or transfer service, as defined in this report, unless equipped with automatic stokers, or other mechanical means of supplying fuel to the fire; (2) that on and after April 1, 1938, no coal-burning steam locomotives of the respective weights on driving wheels above referred to, and used in the services above set forth, built prior to that date shall be used in said services after receiving class 3 repairs or heavier, subsequent to said date unless equipped with automatic stokers or other mechanical means of supplying fuel to the fire; (3) that on and after April 1, 1943, no locomotives of the respective weights on driving wheels above referred to shall be used in the services above set forth, unless equipped with mechanical means of supplying fuel to the fire.

(Turn to next left-hand page)

PERFORMANCE IS PROOF



PROOF of the economic advantages derived from the installation of National Type B Spring-Plankless Trucks is evidenced by the wide application to all varieties of freight equipment.

For more than six years National Type B Trucks have provided quickest wheel changes, complete flexibility, and ability to keep cars in revenue service over longer periods of time.

NATIONAL MALLEABLE AND STEEL CASTINGS CO.
General Offices: CLEVELAND, OHIO
Sales Offices: New York, Philadelphia, Chicago, St. Louis, San Francisco
Works: Cleveland, Chicago, Indianapolis, Sharon, Pa., Melrose Park, Ill.

Canadian Representatives: Railway and Power Engineering Corporation, Ltd., Toronto and Montreal

Supply Trade Notes

D. L. Townsend, formerly with the engineering department of The Symington-Gould Corporation at Rochester, N. Y., has been assigned to the company's Chicago office.

Steel & Tubes, Inc., a subsidiary of the Republic Steel Corporation, Cleveland, Ohio, has opened a branch office in Baltimore, Md., with H. H. Smith in charge.

Ralph C. Harden has been appointed general manager of the eastern division of the Gustin-Bacon Manufacturing Company, Kansas City, Mo. Mr. Harden, who will have his headquarters at New York,

Ralph C. Harden

has had an extensive sales and executive experience. For a number of years he was associated with the Johns-Manville Sales Corporation as salesman, insulation and packing sales manager, division manager and regional vice-president, with headquarters at Chicago. For the past three years, he has served as a general department sales manager with the United States Rubber Products, Inc., New York.

The Pittsburgh Tool-knife & Manufacturing Co., Pittsburgh, Pa., has moved into its own newly equipped plant at 75-81 Sycamore street, Etna P. O., Pittsburgh, Pa. A new office building was erected, adjoining the main plant.

The partnership Thomas Prosser & Son, heretofore consisting of Richard Prosser and Roger D. Prosser, doing business at 15 Gold street, New York, has been dissolved by the death of Richard Prosser on July 12. Roger D. Prosser will continue to conduct the business of that partnership under the name of Thomas Prosser & Son at the same address.

Howard V. Harding has become associated with Lukenweld, Inc., Division of Lukens Steel Company, Coatesville, Pa., as district sales manager in the metropolitan territory with headquarters at 120 Liberty street, New York. John McC. Latimer has been appointed exclusive representative of Lukenweld in Western Pennsylvania territory, with headquarters in the Koppers building, Pittsburgh, Pa.

R. B. Pogue, who has been appointed chief engineer of the American Brake Shoe & Foundry Company, New York, as noted in the September issue, is a graduate of the University of Kentucky. In 1915 he received his master of science degree in railway mechanical engineering and electrical engineering from the University of Illinois. After a short special apprenticeship on the Chicago, Rock Island & Pacific, he entered the inspection department of the American Brake Shoe & Foundry Company in 1916. He was on leave during 1917 and 1918 to serve in the United States Army Signal Corps and Bureau of Aircraft Production, at Buffalo, N. Y. Returning to the American Brake Shoe & Foundry Company in 1918, he was engaged in inspection and operation work, later serving as superintendent of its Burnside plant. Mr. Pogue was transferred to the experimental department in 1927, and was appointed assistant chief engineer in 1929.

Rosser L. Wilson, the newly appointed assistant chief engineer of the American Brake Shoe & Foundry Company, was graduated from Purdue University in 1925, with a mechanical engineering degree. He assisted from 1925 to 1931 in conducting the A.R.A. power brake investigation, two years of this time being spent with the test train on the Pacific Coast. Mr. Wilson joined the American Brake Shoe & Foundry Company in 1935.

Wallace B. Sutherland, assistant to the chief engineer, has been in the service of the American Brake Shoe & Foundry Company since 1913. He began as junior draftsman and in 1920 became chief draftsman. Since his association with the company his duties have been connected with braking problems.

Obituary

Miss A. M. Kelly, secretary and assistant treasurer of the G. M. Basford Company, passed away at her home, 1045 Park Avenue, New York City, on Wednesday, October 6. Miss Kelly was secretary and assistant treasurer of the Basford Company since its founding in 1916, and was active in its affairs up to the time of her death. Prior to her connection with that company she was with the American Locomotive Company and Joseph T. Ryerson & Son. In addition to being secretary of the G. M. Basford Company, she was also secretary and treasurer of the Locomotive Feed-Water Heater Company.

Personal Mention

General

F. S. Robbins has been appointed superintendent motive power of the Atlantic Coast Line, with headquarters at Wilmington, N. C.

R. B. Hunt, master mechanic of the Florida East Coast, has been appointed acting superintendent of motive power and machinery, with headquarters as before at St. Augustine, Fla., succeeding F. S. Robbins.

A. C. Adams, superintendent of motive power, who has retired after more than 50 years of railroad service, entered railway service in 1884 and became a machinist apprentice on the Missouri Pacific in 1886. From 1887 to 1906 he became, successively, machinist, enginehouse foreman, division foreman and master mechanic on the Chicago, Rock Island & Pacific. He then served as master mechanic, in turn, for the Chicago, Burlington & Quincy, the Delaware, Lackawanna & Western, and the New York, New Haven & Hartford. From 1911 to 1914 he was superintendent of motive power of the Spokane, Portland & Seattle and during 1915 was engaged in the supply business. Mr. Adams became master mechanic of the Seaboard Air Line in 1916-1917 and superintendent of shops of the New Haven at Readville, Mass., in 1917. From 1918 to January 1, 1921, he was a member of the Railway Board of Adjustment No. 2, U. S. Railroad Administration, at Washington, D. C., and on January 1, 1921, became superintendent of motive power of the Norfolk Southern.

James H. Wilson, who has been appointed assistant chief mechanical officer of the Norfolk Southern at Norfolk, Va., succeeding A. C. Adams, entered railroad service in 1902 as a machinist apprentice on the Seaboard Air Line. He subsequently served in the electrical department

(Continued on next left-hand page)

James H. Wilson

COMMONWEALTH DEVICES

Reduce
SHOPPING AND RUNNING REPAIR
Costs
of
Locomotives and Tenders

Specify
COMMONWEALTH

- One-piece Locomotive Beds
- Delta Trailer Trucks
- Boxpok Driving Wheels
- One-piece Cast Steel Pilots
- Cast Steel Ash or Fire Pans
- Waterbottom Type Tender Frames
- Swing Motion Equalized Tender Trucks
- Engine Trucks With Improved Rocker Type Centering Device

Among the factors seriously influencing railroad operating income is the element of high shopping and running repair costs of motive power.

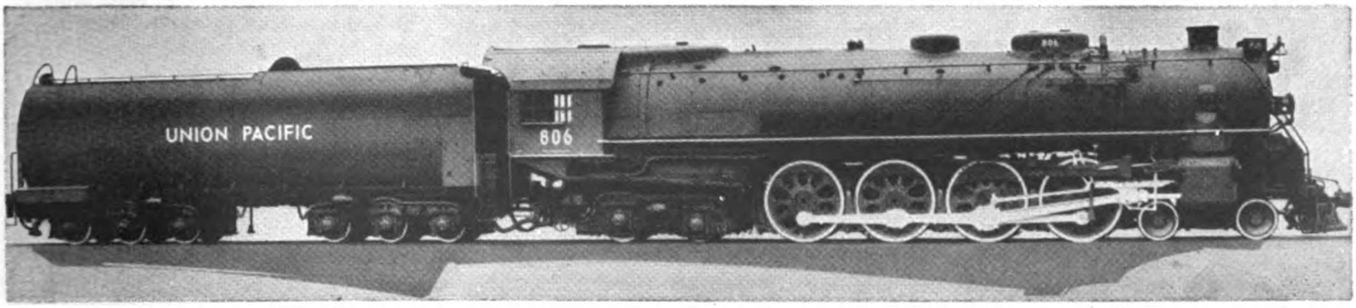
For many years our Engineers have been developing and improving Commonwealth one-piece cast steel railroad devices. Their application materially reduces shopping and repair costs which are inherently high in fabricated construction.

At this time, perhaps as never before, conditions make it necessary for the railroads to adopt all possible methods and devices that will improve ratios between expenditure and income.

New or rebuilt power constructed with Commonwealth products will help meet the situation by insuring utmost maintenance economies and increased serviceability.

GENERAL STEEL CASTINGS

EDDYSTONE, PA. GRANITE CITY, ILL.



of the Atlantic Coast Line, and in October, 1917, became chief electrician of the Norfolk Southern. He was promoted to the position of chief mechanical inspector and assistant superintendent of motive power on March 16, 1934, and on September 1 of this year became assistant chief mechanical officer.

LESTER H. KUECK, assistant chief mechanical engineer of the Missouri Pacific, has been appointed chief mechanical engineer. He has been in the employ of this

Lester H. Kueck

company for 20 years. Mr. Kueck was born on July 20, 1895, at Sedalia, Mo., and entered the service of the Missouri Pacific on April 1, 1917, as general draftsman. From September 21, 1920, to February 15, 1924, he served as a general draftsman on the Texas & Pacific (controlled by the Missouri Pacific) at Marshall, Tex. In 1924 he returned to the Missouri Pacific as general draftsman at St. Louis, holding this position until February 2, 1926, when he was advanced to chief draftsman. On September 1, 1935, Mr. Kueck was promoted to assistant chief mechanical engineer, and held this position up to the time of his recent appointment.

Master Mechanics and Road Foreman

J. F. HUNT has been appointed assistant master mechanic of the Pittsburgh division of the Pennsylvania.

ALFRED J. GRAHAM, assistant road foreman of engines of the Pocahontas division of the Norfolk & Western, has been appointed road foreman of engines of the Pocahontas division.

FRED R. LITZ, electrical engineman on the Pocahontas division of the Norfolk & Western, has been appointed assistant road foreman of engines of the Pocahontas division, succeeding Alfred J. Graham.

Shop and Enginehouse

M. H. WESTBROOK, superintendent of shops of the Grand Trunk Western, at Battle Creek, Mich., retired on September 1 after 46 years of service on that road.

C. E. MILLS has been appointed general enginehouse foreman of the Boston & Albany, with headquarters at Allston, Mass., succeeding A. L. Wright.

A. L. WRIGHT, general enginehouse foreman of the Boston & Albany at Allston, Mass., has been appointed shop superintendent, with headquarters at West Springfield, Mass., succeeding J. F. Murphy, deceased.

WAYLAND F. SMITH, air brake foreman of the Atchison, Topeka & Santa Fe at San Bernardino, Calif., retired on September 1. Mr. Smith entered the service of the Santa Fe in September, 1884, at the age of 14.

Purchasing and Stores

E. L. FRIES, special representative of the executive vice-president of the Union Pacific, with headquarters at Omaha, Neb., has been appointed general purchasing agent, with headquarters at Omaha.

CHARLES A. KEEBLE has been appointed purchasing agent of the Union Pacific, with headquarters at Los Angeles, Cal. Mr. Keeble was born on March 2, 1899, at Los Angeles. After attending Occidental college, he entered railway service in January, 1918, with the Southern Pacific. He entered the service of the Union Pacific in the stores department in 1919, and on September 12, 1922, was assigned to the chief engineer's office. On January 1, 1923, he became connected with the purchasing department, where he advanced through various positions until September 1 of this year, when he became purchasing agent.

Charles A. Keeble

Obituary

FRED JACKSON, master mechanic of the Lehigh & Hudson River Railway, died on September 16 at his home at Warwick, N. Y.

GEORGE WHITELEY, superintendent of the motive power and car department of the Canadian Pacific, with headquarters at Toronto, Ont., died on September 29.

CHARLES S. BRANCH, master mechanic of the Alton, with headquarters at Bloomington, Ill., died at his home on September 5, following an emergency operation for appendicitis performed a week previously.

C. O. DAVENPORT, master mechanic of the Chicago, Burlington & Quincy, with headquarters at Casper, Wyo., died suddenly of a heart attack on September 20 while standing on the station platform at Casper.

JOHN F. MURPHY, superintendent of shops of the Boston & Albany at West Springfield, Mass., died on August 29. Mr. Murphy was born in 1880 at Springfield, Mass. He attended the public and evening trade schools, and on May 1, 1898, became a helper in the enginehouse of the Boston & Albany. In 1902 he was transferred to the shops and in 1908 was the first apprentice to serve his time on the B. & A. He then became a machinist leader and in 1912 was promoted to the position of machine shop foreman. In 1928 he was appointed assistant general foreman of the locomotive shops, and from July, 1935, until his appointment as superintendent of shops early in 1936 had been acting superintendent of shops. Mr. Murphy was one of the organizers of the Boston & Albany Supervisors' Clubs. He was always an active supporter of apprentice training.

J. F. Murphy

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

ELECTRIC WATER COOLERS.—Electric water coolers for railway application are illustrated and described in the four-page bulletin issued by General Electric, Schenectady, N. Y.

DART UNIONS.—The catalog published by the E. M. Dart Manufacturing Company, Providence, R. I., contains data on Dart pipe unions and fittings, with color illustrations showing the full-bearing, ball-joint construction of the unions.

HOISTING EQUIPMENT.—Every type and modification of Yale hand chain hoists are fully described and illustrated in the 40-page catalog of the Yale & Towne Manufacturing Company, Philadelphia, Pa. Another booklet of 12 pages is devoted to chain hoists, a spare parts list and oiling instructions.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, Railway Master Mechanic, and Boiler Maker and Plate Fabricator. Name Registered, U. S. Patent Office

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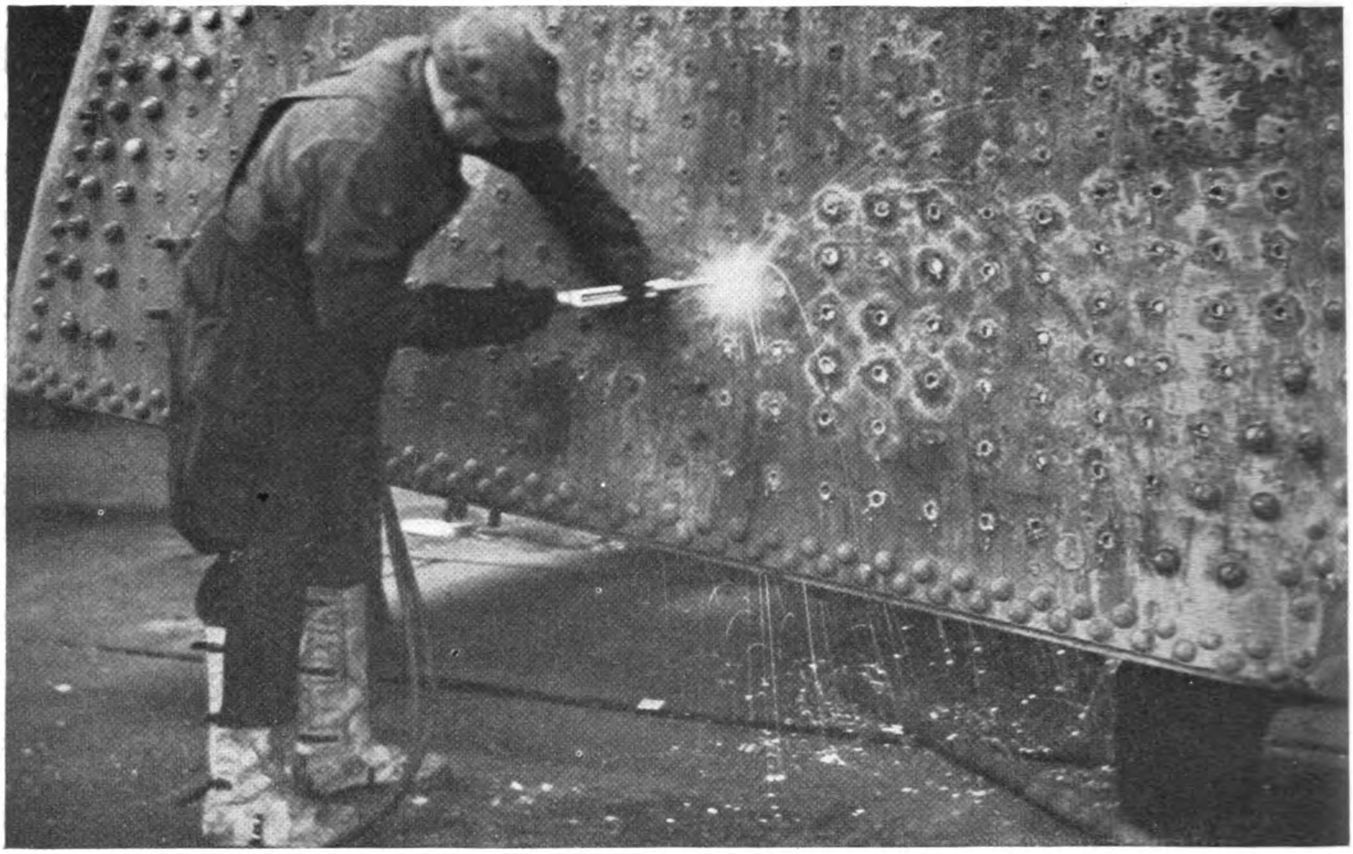

RAILWAY
MECHANICAL ENGINEER

Methods used on the Canadian National for

Maintenance of Diesel Engines*

By I. I. Sylvester†

Steam-locomotive maintenance methods and organizations as applied to the repairing of Diesel engines and factors involved in the cost of Diesel-engine operation are discussed herein

THE purpose of this paper is to present the results of experience gained in the maintenance of three principal groups of rail-car engines of from 200 to 350 hp., comprising 26 units which have run over ten million miles in passenger service. These engines were placed in service on the Canadian National in 1925, 1927, and 1930, and even though they include improvements evolved over a five-year period, their maintenance problems are almost identical.

Soon after the commencement of Diesel-electric rail-car service, it was recognized that the oil-electric car offered great possibilities for economical operation and high availability, provided a satisfactory program for maintenance could be worked out. The lack of experience and knowledge on the part of those called upon to handle the engines, and of the designer and builder, regarding operating conditions, was a serious handicap in the early days. The seniority system, commonly followed in railway organizations, sometimes mitigated against the selection of the most capable men. Also the locomotive-shop staff had not previously been called upon to perform the type of work required in maintaining the fine working clearances of the wearing parts. However, these conditions have been quite general on railroads on this continent and are mentioned here only because they had such an influence on the amount and type of maintenance required.

The most desirable condition is found in large numbers of identical equipment, centrally located, as expert supervision can be provided and the staff soon becomes accustomed to the new routine. The other extreme is found in rail-car service where the units are operated over an extremely wide territory, which interferes with efficient training and seriously affects availability of the equipment due to deadheading to and from a centrally located repair point. This latter condition applies particularly on the Canadian National, and the maintenance methods which follow were developed to cope with this situation. All these problems have demanded as much attention as the technical difficulties—possibly more.

The engines to which this paper applies in particular are four-cycle direct-injection engines of both British and American manufacture, the original research work having been carried out by the Wm. Beardmore Company at Glasgow prior to 1924 and the later development by the Westinghouse Company at their South Philadelphia plant. The crankcases of these engines are of cellular type, arranged for separate cylinder liners and made of cast steel. The crankshafts are supported in main bearings between each cylinder. Collar studs hold the individual cylinder heads and liners to the crankcase, the main bearings being attached to the crankcase in a similar manner. The crankshafts are of carbon, nickel, and chrome-nickel steel forgings machined all over and drilled for pressure lubrication from the main journals to the crankpins. Cast-aluminum cylinder heads with steel valve seats to accommodate dual inlet and exhaust valves are also used on all these engines. Each head carries its rocker-arm mechanism and a single atomizer which is located at the center of the head where it is easily removed. Aluminum pistons, hollow floating wrist pins, and forged-steel connecting rods are also features of these engines. The development of crank end bearings for the connecting rods has been of considerable interest and will be dealt with later.

The cast-steel crankcase and underbed of thin section, together with rather extensive use of aluminum for such parts as pistons, cylinder heads, and gear cases have resulted in weights between 16 and 24.2 lb. per b.hp. for these engines, which is in the lightweight class for rail service. The essential particulars of these units, which were the subject upon which maintenance investigations were carried out between 1925 and the present time, are given in Table I. These include two columns of figures showing the maximum and minimum sizes, weights, and conditions. The tabulation of the extremes in Table I indicates the design limits of the principal rotating and reciprocating parts around which most of the maintenance problems have centered.

The first feature of our maintenance consists of daily

Table I—Principal Proportions of The Diesel Engines

	Minimum	Maximum
Cylinder bore, in.	8	9
Stroke, in.	12	12
Brake mean effective pressure, lb. per sq. in.	77	82.5
Maximum cylinder pressure, lb. per sq. in.	750	800
Diameter of main bearing, in.	5.00	5.00
Length of main bearing, in.	3.70	4.65
Diameter of crankpins, in.	4.75	5.00
Effective length of crankpins, in.	2.29	4.04
Ratio of shaft diameter to cylinder bore	0.555	0.575
Ratio of wrist-pin diameter to cylinder bore	0.315	0.322
Ratio of piston length to cylinder bore	1.4	1.9
Ratio of connecting-rod length to cylinder bore	2.43	2.21
Total weight of connecting rod, lb.	37.94	70.19
Weight of crank end of connecting rod, lb.	26.38	54.09
Weight of wrist-pin end of connecting rod, lb.	11.56	16.11
Weight of piston, lb.	18.19	35.00
Number of pressure rings	4	6
Number of scraper rings	1	3

* Abstracted from the paper "Maintenance of High-Speed Diesel Engines on the Canadian National Railways," which was presented at the semi-annual meeting of The American Society of Mechanical Engineers held at Detroit, Mich., May 17 to 21, 1937, and published in the May, 1937, issue of the A.S.M.E. Transactions.

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reports made out to show the fuel, lubricating oil, and other supplies used, mileage operated and load hauled, together with any trouble experienced during operation, and finally the repairs and inspection which are made daily. These data are compiled monthly to show the average condition obtaining for each car and, as all the equipment is included in this report, it permits the individual maintainer to compare his performance with that of others. This report also shows any troubles which occur with such frequency as to warrant investigation, thus keeping problems in order of their importance before the supervising staff. An analysis of these records over extended periods of operation also indicates any inherent weakness which can be remedied in new designs.

In a general way the practices developed are a combination of railway maintenance ideas and those used in the repair of gasoline engines. Many of the methods employed are quite in line with those generally accepted in fleet operation of trucks and busses. In fact, much inspiration has been drawn from this source when grappling with the more difficult problems. In these installations engine size and weight have been kept to a minimum with the result that provision for successive wear and remachining is not generally made to the same extent as in steam-locomotive work. One principal difference lies in the rather extensive use of welding and,

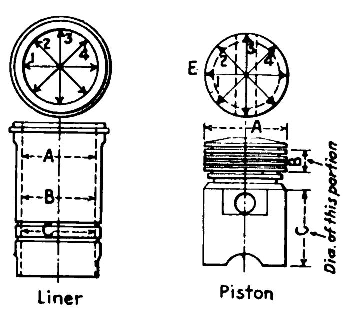
CANADIAN NATIONAL RAILWAYS

OIL ELECTRIC CARS

RECORD OF PISTONS AND LINERS

Car No. 15829
Eng. Type Beardmore-six
Eng. No. 115
Date July 30, 1928
Miles 82,877

		LINERS				PISTONS				PISTON CLEARANCE	
		1	2	3	4	1	2	3	4	D	E
1	A	8.280	8.281	8.281	8.281	8.215	8.216	8.218	8.217	0.063	0.065
	B	8.251	8.254	8.251	8.254	8.221	8.220	8.228	8.225	0.023	0.030
	C	8.254	8.250	8.247	8.250	8.232	8.235	8.235	8.234	0.012	0.022
2	A	8.256	8.258	8.255	8.256	8.213	8.212	8.219	8.214	0.036	0.043
	B	8.255	8.253	8.254	8.256	8.219	8.220	8.225	8.222	0.029	0.036
	C	8.253	8.251	8.252	8.254	8.232	8.235	8.238	8.235	0.014	0.021
3	A	8.284	8.285	8.282	8.282	8.215	8.212	8.219	8.214	0.063	0.069
	B	8.256	8.252	8.259	8.257	8.221	8.223	8.229	8.223	0.030	0.035
	C	8.253	8.253	8.251	8.253	8.231	8.235	8.241	8.233	0.010	0.022
4	A	8.275	8.275	8.268	8.273	8.209	8.214	8.217	8.214	0.051	0.066
	B	8.257	8.257	8.252	8.253	8.219	8.224	8.226	8.223	0.026	0.038
	C	8.254	8.254	8.248	8.250	8.230	8.235	8.240	8.235	0.008	0.024
5	A	8.270	8.272	8.271	8.269	8.215	8.218	8.217	8.212	0.054	0.055
	B	8.254	8.254	8.252	8.253	8.223	8.225	8.226	8.223	0.026	0.031
	C	8.253	8.253	8.247	8.250	8.235	8.235	8.237	8.236	0.010	0.018
6	A	8.271	8.269	8.268	8.268	8.216	8.218	8.219	8.216	0.050	0.055
	B	8.253	8.253	8.255	8.256	8.222	8.223	8.225	8.222	0.030	0.031
	C	8.250	8.250	8.253	8.254	8.231	8.235	8.236	8.232	0.017	0.019
7	A										
	B										
	C										
8	A										
	B										
	C										



REMARKS

Ring grooves badly worn on all pistons, especially on the exhaust side. Land broken between No. 1, No. 2 and No. 3 ring grooves on No. 1 piston.

Recorded at Edmonton
Recorded by I. I. S.

CANADIAN NATIONAL RAILWAYS
OFFICE OF CHIEF ELEC. ENGR.
MONTREAL, QUE., DEC., 10, 1930

Fig. 1—Record of the rate of piston and cylinder-liner wear

of late, chromium plating as a means for reconditioning wearing parts. Fusion welding, as developed in steam-locomotive service, is now being used extensively in Diesel-engine repairs and much progress has been made in recent years in the use of the electric arc and acetylene flame for the building up of worn parts as well as repairing fractures. Good results were not obtained in this new application without overcoming several technical difficulties because the original development on the railway had to do with structural-steel plates and boiler work in which the metal was quite readily welded. However, in the repair end, large varieties of special metals had to be dealt with and in many instances heat-treatment to regain physical properties of the finished part became a problem.

Considerable ingenuity has been required to develop successful welds on such parts as pistons, cylinder liners, and valve gear. The service engineers of companies which supply welding materials have been of great assistance in the development of suitable welding rods for this work and in providing instructions for their satisfactory use. This process is now responsible for reduction in our maintenance costs and some descriptions of unusual repairs by this method are given under various headings which follow.

Within the last year or so we have been investigating the merits of hard chromium plating in an effort to lower the rate of wear on certain parts and also as a means of regaining the original size where possible. Worn surfaces on pins and journals of crankshafts, wrist pins, cylinders, and various other small parts have been built up with chromium and satisfactorily salvaged. This type of plating must not be confused with the decorative plating which is used more or less in the form of a lacquer to preserve the copper-nickel plating underneath, as it is applied directly to the base metal. We are using thicknesses varying from 0.003 to 0.015 in., depending on service conditions. Excessively thick plates are not found desirable and, for that reason, the original sizes are not always regained.

Cylinders

The cylinders in these engines are in the form of relatively thin tubing, accurately machined all over, and are snugly fitted in the crankcase. They are of the wet type, being surrounded by cooling water, and the joint at the bottom is made by means of rubber rings.

Our lack of information regarding the rate of wear on cylinders and pistons of rail-car engines, some ten years ago, resulted in the introduction of a system of recording the sizes whenever these parts were dismantled. A copy of the form which has been used for recording this information is shown in Fig. 1. At first it was felt that these records would give us an indication of the direction of wear around the circumference of the cylinder and possibly lead to correction of it. However, there was found to be no regularity in this regard, some 60 per cent showing maximum wear at right angles to the crankshaft and the remainder lengthwise or at some intermediate angle. We have been unable, even by painstaking study of a great number of measurements, to associate this feature with any other detail of engine construction or performance. The principal value of this form has been in the determination of average rate of wear on cylinders of different groups of engines, thereby providing a basis for the maintenance program. The comparison of wear resulting from the use of different fuels and of different cylinder materials has also been gained from these records, and they have also shown the accuracy with which replacement cylinders are installed.

A typical example of the location of maximum wear is shown in Fig. 2. This illustration is exaggerated to show the details of the worn portion. Although the wear is always greatest at top dead center, it is rather unusual for it to be almost entirely confined to such a short dis-

tance from top-ring travel. The wear at mid-stroke is always negligible and is only perceptible at bottom dead center on these engines.

What can be accomplished in reconditioning cylinders for further operation is, in the main, controlled by the number of engines involved. Several factors, however, must be given careful consideration, and too much emphasis cannot be placed on the value of accurate measurements of the wear occurring on both the pistons and cylinders. The analysis of these data permits important decisions to be made, such as, whether reconditioning will be necessary and economical on both of these parts or if this attention can be confined principally to the cylinders. Where piston wear is relatively low, it is most economical to regain the original cylinder size by applying a bushing to existing cylinders as in locomotive service, thus avoiding any necessity for work on the pistons or supplying off-size rings.

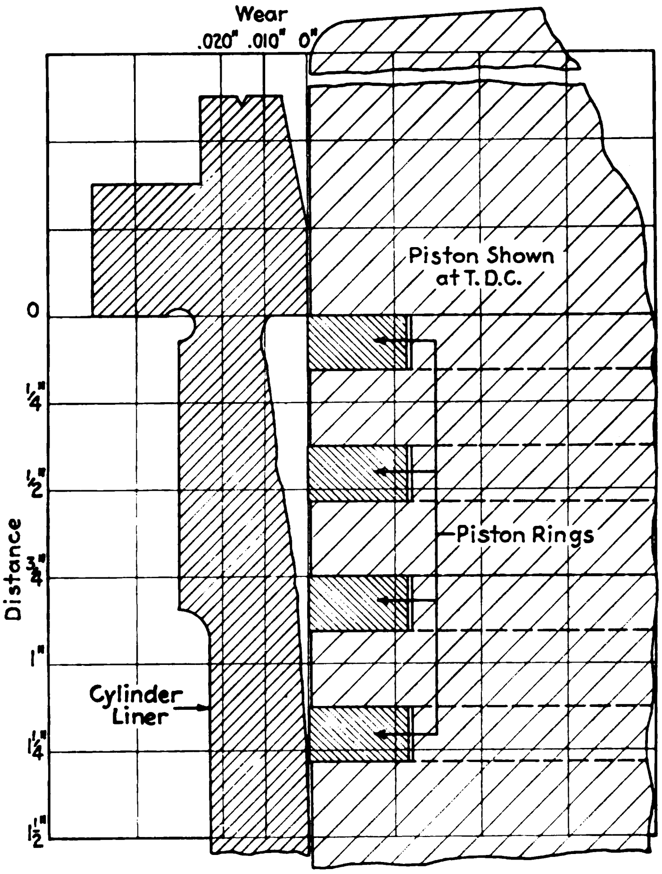


Fig. 2—Location of maximum wear on a cylinder liner—Illustration exaggerated to show details of the worn portion

Fig. 3, which was drawn from an inspection of a large number of forms such as shown in Fig. 1, shows the average rate of wear on the three groups of engines which we have in passenger service. An analysis of cylinder wear on individual engines produces a curve showing a gradual increase in wear up to 45,000 to 55,000 miles and then the wear is accelerated considerably. The shape of the top curve is more in line with the usual individual engine investigations. However, in plotting several hundred measurements, it is impossible to establish anything but a straight line as being the average rate of wear which can be expected. These curves are all the result of wear at top dead center on mild-steel cylinders which are fitted with aluminum pistons.

There are over 150 cylinders of similar type and size in service, which has permitted the establishment of sizes both above and below those which were set up by the manufacturers. It has been found that 1/16-in. wear on the diameter can be economically tolerated, giving due consideration to the increase in lubricating-oil consumption which results from wear on this part. In reconditioning, however, steps of 0.025 in. are desirable and economical in the reclaiming methods described later. It requires about 0.075 in. oversize to clean up properly a cylinder worn 1/16 in. because of the wear being quite eccentric, or otherwise irregular, relative to the center line of the cylinder. In establishing these sizes it has been necessary, of course, to consider them in relation to similar steps on the pistons and the stocking of seven sizes of piston rings to suit. In the beginning, existing cylinders were bored out and oversize pistons applied.

Table II—Sizes and Letter Designations for Pistons and Cylinders

Symbol	Size	Symbol	Size
A	0.075 in. oversize	*E*	0.025 in. undersize
B	0.050 in. oversize	*F*	0.050 in. undersize
C	0.025 in. oversize	*G*	0.075 in. undersize
D	Standard size		

Later, as a result of an accumulation of worn standard-size pistons, undersizes down to 0.075 in. below standard were established. The symbols for size identification, which are stamped on both pistons and cylinders, are shown in Table II.

The arrangement does not require the previous size of the piston to be removed, but merely the addition of the new size. On cylinders, the sizes are stamped on the outside diameter of the collar which extends above the crankcase where it can be observed without removal of the head on most of the engines. The curvature of this surface permits easy removal of the previous size symbol when the cylinder is being rebored.

We are also reconditioning cylinders by depositing a band of metal on the worn portion for about 3 in. down from top dead-center position, with the electric arc. The cylinder is cleaned by grinding with a hand grinder to remove the surface metal and it is revolved during the welding process to keep distortion to a minimum. No attempt is made to regain the cylinder size by this method, but they are bored out about 0.015 in. above the original size and ground to 0.025 in. oversize. This means that a cylinder might be worn 1/16 in., but be

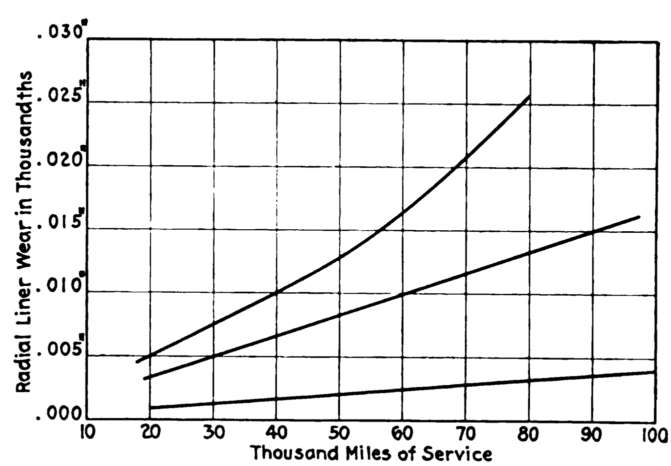


Fig. 3—Average rate of cylinder wear in rail-car engines

returned to service only 0.025 in. larger than previously. A section through the upper part of a cylinder which has been reconditioned in this manner is shown in Fig 4. This enlarged section shows the typical porosity of the electric weld. The deposited metal, however, is considerably harder and more wear-resistant than the orig-

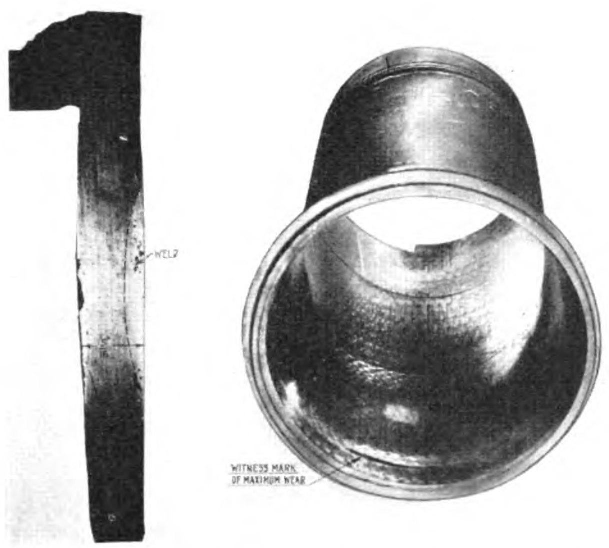


Fig. 4—Left: Worn portion of a cylinder repaired by electric welding—Right: Cylinder liner chrome plated for about 4 in. down from the top-ring travel

inal cylinder material. The pores possibly are an advantage in regard to the retention of lubricant on this zone where the high temperatures often interfere with proper lubrication.

Fig. 4 also shows a cylinder liner from one of the six-cylinder engines which was chromium plated at the worn portion for about 4 in. down from the top-ring travel. This was taken while the cylinder was being reground after plating. It had been worn about 0.024 in. on the diameter and was plated sufficiently to bring it back to standard size and about 0.010 in. to clean it up. The vertical marks from the original use of this cylinder and the ring formed at bottom dead center are noticeable. A witness mark of the groove caused by maximum wear at the top is just in evidence and was removed during the finish-grinding. It is possible to set up these cylinders by the original surface and the measurements indicate that the cylinder is within 0.002 in. of the original size. The results of this application are not yet available. However, it will be watched with particular interest, inasmuch as it has to contend with elevated temperatures as well as abrasion. The fact that chromium is particularly resistant to chemical action of the fuel oil may also provide some data in connection with the "corrosion theory" which is being discussed so extensively.

In addition to harder wearing surfaces resulting from the various reconditioning methods which have been used on mild- and tempered-steel cylinders, some very interesting information pertaining to the use of cast iron and nitrided steel for this purpose has been developed on these engines.

In the application of cast iron in place of steel, it has been necessary to reduce the cylinder size somewhat in order to provide sufficient strength, and this may have had an influence on the results. We have been unable to find a great difference in rate of wear on nickel iron, ordinary gray iron, or iron cast centrifugally. Any of them, however, appear to wear only about half as rapidly as mild steel. The greatest difficulty with the use of this metal on these particular engines, which were designed for steel cylinders, is in the application within the narrow confines of the crankcase.

Cylinders of nitralloy steel are giving a very creditable performance. Tests have been carried out over 259,000 miles in obtaining comparisons. These indicate that the maximum wear is 0.007 in. in 80,000 miles, which is only about one-fourth to one-fifth the amount on mild steel in similar service. The attempts which have been made to reclaim any cylinders of this material are unprofitable because of the difficulty in grinding the excessively hard surface. Also the second wear is inferior because the surface hardness is removed.

The pitting of the steel cylinders, as a result of the action of the cooling water on the outside, is also a problem which has been dealt with in maintenance. Zinc and aluminum spraying of some of the cylinders has been used to prevent this action in order to continue the cylinders in service for a longer period. A certain amount of pitting occurs at all times, but usually the cylinder is worn to the limits mentioned before serious weakness results. A limit of $\frac{5}{32}$ in. wall thickness, measured at the bottom of the deepest pit, has been set up for steel cylinders in order to avoid this condition. All liners are coated with a corrosion-resisting paint during manufacture or reconditioning to counteract the

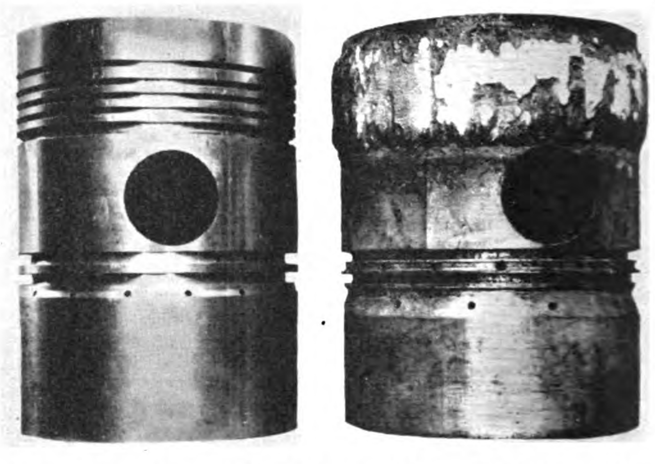


Fig. 5—Left: Piston which had the ring belt machined off, acetylene welded, heat-treated and machined—Right: The piston before machining

attack of the cooling water. No trouble whatever has been experienced with pitting on cast-iron or nitrated cylinders.

Pistons

Of the various wearing parts of these engines, the pistons present the most complex problem, and have been the subject of considerable study both as to design and maintenance. The almost continuous variation in speed and load over wide ranges, which has to be dealt with in railway traction, makes greater demands on the piston than most services. Further, the introduction of aluminum-alloy piston, so essential to these high-speed, light-weight engines has tended toward higher lubricating-oil consumption—first, because of the varying clearances between the piston and cylinder resulting from the previously mentioned service requirements; and, second, because the comparatively soft aluminum alloy wears more rapidly than other piston materials.

Considerable painstaking work and time have been necessary in developing maintenance methods to meet these conditions. However, a very satisfactory reduction in lubricating-oil consumption and reconditioning these parts has followed our efforts and we have been enjoying the benefits for several years.

Of the sand-cast, die-cast and forged-aluminum pistons which have been employed since 1925, the forged metal is most suitable, as it is stronger, more ductile and wear-resistant. It is more expensive, however, because of the

more costly process of manufacturing the metal and machining this part from the solid forging.

Wear of the ring grooves in any of the alloy pistons appeared as a difficulty early in the operation of these engines. It was, in fact, this item which determined their useful life. In bringing this factor within reasonable limits, it has been necessary to consider the effect of the fuel oil as well as the design and metal from which the pistons are manufactured. In the early days, fuel specifications were written in broad terms to take care of the very wide territory in which these engines operated. However, it seems that two fuels can have apparently identical physical characteristics and yet the reaction on the piston from a wear standpoint may be widely different. Improved fuel specifications, which have been developed, and the adoption of narrower and diametrically thicker rings proved helpful. However, there was still the necessity for reconditioning the ring grooves. Wear on the top grooves has been limited to 0.006 in.

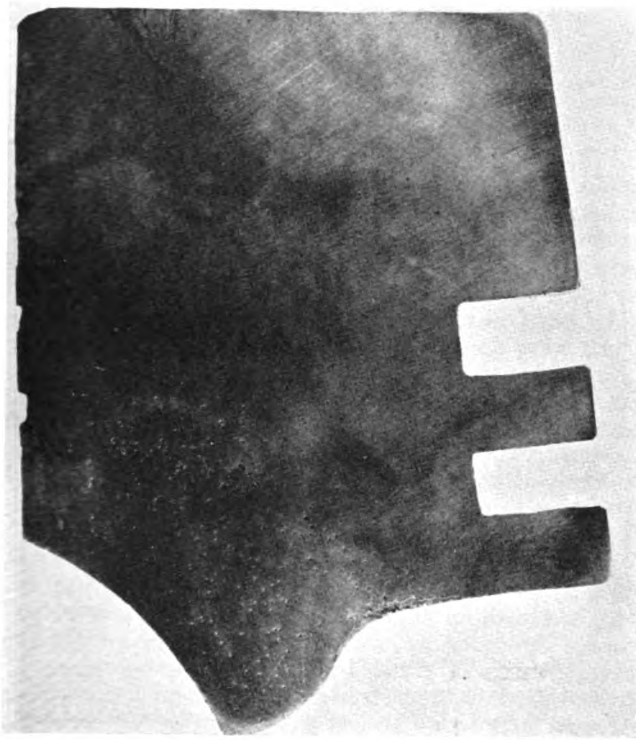


Fig. 6—Enlarged section of a piston before being acetylene welded

and when this is exceeded the grooves are machined out to take overwidth rings. It has been proved that good piston rings in equally good grooves are steps in the right direction, and much of our effort has been directed toward this end.

Engines such as these, designed with minimum weight, of necessity have the wrist-pin hole somewhat above the center of the piston, which has a very limiting effect on the width of the lands between the piston rings. This restriction does not allow for much widening of the groove until the land is altogether too weak and subject to breakage. We have, therefore, limited this feature of our reclaiming operations to 0.025 in. over standard width. The rate of wear on the ring lands remained so much greater than that occurring on the rubbing surfaces of the piston or wrist-pin hole that there are many pistons which could be used further provided the original condition could be regained at the ring belt. To accomplish this, acetylene welding is being employed and, in Fig. 5, at the right, is shown a piston which has had the entire ring belt machined off and new metal deposited by this method. At the left appears a similar piston after heat-treatment and machining. In the investigation prior to the adoption of this method, sand-cast and die-cast pistons were examined both before and after welding, and some of the results are shown in Fig. 6. This shows an enlarged section of an unwelded piston located in this work. This particular one is somewhat worse than average regarding porosity. Fig. 7 shows a section illustrating a welded piston, for comparison; this enlargement shows the condition of the welded ring belt after machining. It will be noted that the porosity even in the newly deposited lands is not nearly as serious as in the original casting shown in Fig. 6. The strength of original and welded lands on pistons was determined by the load required to break them off one at a time. Typical loads required to break lands off an original piston are 35,000, 36,000, and 35,500 lb. while typical loads for a welded piston are 60,000, 66,000; and 64,000 lb.

The machining of the outside diameter of the pistons has been treated in line with that described for the cylinders. The welded pistons are always machined down 0.025 in. in diameter which removes any distortion caused during the welding process. The wrist-pin holes were found to close in slightly under this treatment and this is an advantage, since it permits the wrist pin to be refitted to standard clearances.

In connection with newly manufactured pistons of 8 to 12 in. diameter, it has been demonstrated repeatedly that a certain amount of distortion takes place soon after they are placed in service, and, in connection with reconditioned parts, this does not seem to be noticeable. In the ordinary course of events, pistons which have been reconditioned after 75,000 miles have been fitted with smaller clearances without any evidence of seizure.

Diesel-engine crankshafts are handled in a manner similar to the pistons and liners in regard to records of

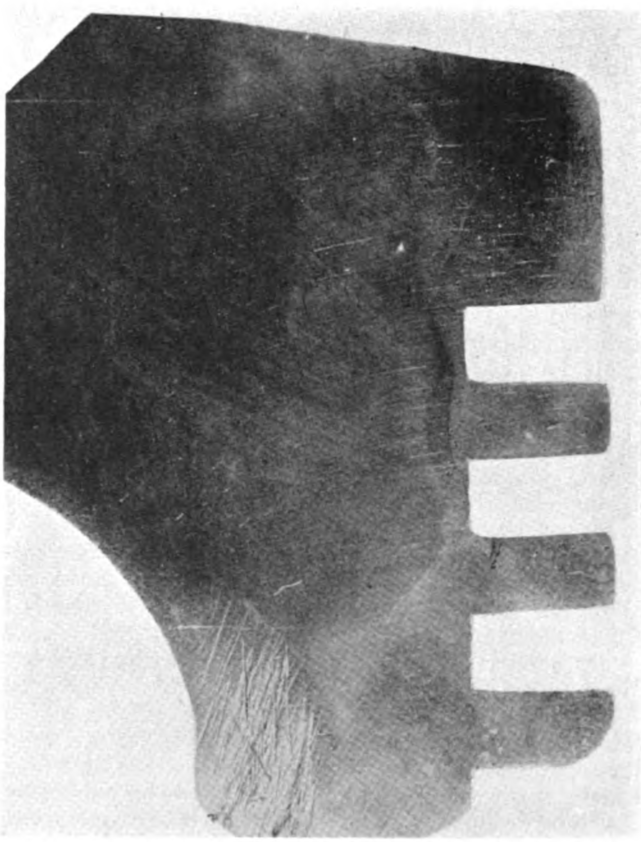


Fig. 7—Enlarged section of a piston after being acetylene welded

wear and sizes. In Fig. 8 is shown a copy of this form which is typical of the wear occurring on this part. In some studies made several years ago comparisons were made between nickel, chrome-nickel, and carbon steels for wear resistance, and it was found that there was very little choice between them. However, in replacement, the trend has been toward alloy steels because of the harder bearing surfaces and greater strength. On main journals, the wear varies between one and two thousandths on the diameter in 100,000 miles and the crankpins show six to nine thousandths during this period on the usual run of crankshaft steel.

CANADIAN NATIONAL RAILWAYS

OIL ELECTRIC CARS

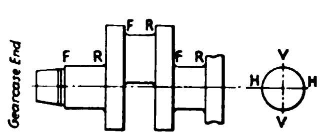
RECORD OF ENGINE SHAFT MEASUREMENTS

Car No. 15829
Eng. Type Beardmore-six
Eng. No. 113
Date January 20, '31
Miles 199,548

		Diameter of journals		Difference		Diameter of crank pins		Difference	
		F	R	V-H	F-R	F	R	V-H	F-R
1	V	4.9960	4.9940		0.0020	4.7280	4.7300		0.0020
	H	4.9980	4.9965		0.0015	4.7280	4.7300		0.0020
2	V	4.9960	4.9960		0	4.7290	4.7320		0.0030
	H	4.9950	4.9955		0.0005	4.7300	4.7315		0.0015
3	V	4.9950	4.9950		0	4.7270	4.7310		0.0040
	H	4.9955	4.9955		0	4.7275	4.7320		0.0045
4	V	4.9940	4.9925		0.0015	4.7325	4.7345		0.0020
	H	4.9935	4.9935		0	4.7335	4.7355		0.0020
5	V	4.9940	4.9945		0.0005	4.7290	4.7320		0.0030
	H	4.9950	4.9960		0.0010	4.7305	4.7315		0.0010
6	V	4.9960	4.9970		0.0010	4.7315	4.7325		0.0010
	H	4.9960	4.9965		0.0005	4.7325	4.7335		0.0010
7	V	4.9950	4.9960		0.0010				
	H	4.9965	4.9975		0.0010				
8	V	4.9950	4.9955		0.0005				
	H	4.9965	4.9970		0.0005				
9	V								
	H								

NOTES

F = Front nearest to gear case
R = Rear
V = In vertical plane
H = In horizontal plane
Difference between V and H indicates ovality and should be zero.
Difference between F and R indicates and should not exceed 0.002 in.
When being measured the crankpin to be on top dead center.
If serious ovality is found on main journals, the measurements shall be recorded in relation to a top dead center.



Shaft No. 33263 N 1097

Recorded at Winnipeg, Man.
Recorded by Geo. F. Shaw

CANADIAN NATIONAL RAILWAYS
OFFICE OF CHIEF ELEC. ENGR.
MONTREAL, January 30, 1931

Fig. 8—Form for recording rate of crankshaft wear

The Nitralloy crankshafts which were applied several years ago are standing up remarkably well, and, on the average, indicate the wear to be about one-sixth that usually found. In practically every instance, regardless of the type of steel, however, the crankpin wear is four to five times that found on the main journals. In reconditioning crankshafts the practice is to turn the crankpin and journal which is in the worst condition first, and then use the size which has been thus established for the remaining pins and journals. In this way it is not found necessary to establish definite undersizes for this part, and in a measure this has extended the life of the shafts, as only sufficient metal is removed to true them up.

Very good results have been obtained with a Webber tool in turning crankpins. This tool is one of the type which is used in the lathe and follows the crankpin around in its normal path when revolving on the main journal centers. Any pins which are oval are first filed to make them round so that the tool will be guided by a fairly true surface throughout the entire operation. Wooden polishing blocks are employed and fine abrasive compounds are used in the final finishing, producing accuracy in line with manufacturers' required tolerances.

Correcting-Rod Crank Bearings

One of the problems which developed in the early use of these engines, and for which the maintenance staff was obliged to find a solution, related to crank-bearing failures. This amounted to cracking of the babbitt lining in the rod or top half of the bearing which continued until most of the babbitt in the high-pressure area was loose and broken in small pieces. If this condition was not detected, the detached pieces pounded out until they interfered with lubrication, causing heating, or the bearing shell came down on the crankpin. It was found that it did not take long for most of the babbitt to become loose after the initial crack had formed and it was not unusual for loose babbitt to go unnoticed until the bearing was removed for inspection. The loose pieces would, of course, fall out when the bearing was disturbed, and renewal was necessary. Cracking never occurred in the bottom half of the bearing and the main bearings also were practically trouble free. The fact that the babbitt metal employed included all the popular tin-base alloys and from failures which occurred with several of these which were applied under expert supervision, there was a strong belief that the loads were too high. To offset this, however, a study of the records indicated that some bearings operated in excess of 200,000 miles without renewal. These, of course, were rather exceptional in the early days. However, these rare occurrences indicated the direction of improvement, and final solution of the problem followed.

Table III—Analysis of Bearing Material

Element	Babbitt, per cent	Lead-bronze, per cent
Copper	1.00	77
Lead	78.75	15
Tin	1.25	8
Antimony	18.00	..
Arsenic	1.00	..

Flexing of the bottom end of the connecting rods was given attention and, in later installations, bearing sizes were increased and the rods strengthened. However, the trouble continued and, at one stage of the investigation, several methods of babbitting the crank bearings were tried. These included babbitting direct on the steel rods without the use of shells, and the use of bronze-lead combinations which were only partially successful. The experience which was gained resulted in some very definite ideas regarding the best type of crank bearing for railway traction.

Protection of the crankshaft against damage under severe and abusive conditions is an important factor because passenger trains must be on time if humanly possible. This means that under abnormal conditions an engine may be operated without a proper supply of lubricating oil, with disastrous results. The development of a crank-bearing shell which can be operated after the babbitt has disappeared without damaging the shaft is the answer. The use of a shell of this type which can be easily removed for inspection or replacement, has permitted reasonable maintenance and provided good protection for the crankshaft.

As a consequence of the poor results obtained with the bearings in the early days and the time required to obtain replacements and deliver them to remote parts of the railway system, attempts were made to manufacture bearings in the railway shops. At first these were not very successful, but by the use of special babbitt with high lead content, together with improved practice regarding its application, the crank bearings have ceased

to be a troublesome feature in maintenance. Lead is usually thought of as an extremely soft and ductile metal. However, the addition of antimony and arsenic gives it a surprising hardness without interfering with its antifriction qualities.

Bronze shells with a phosphorus content were also found to be unsuitable and the best results are being obtained with babbitt, and shells of the composition given in Table III. The jig which is employed is made solid in order to retain the heat and it is kept between tempera-

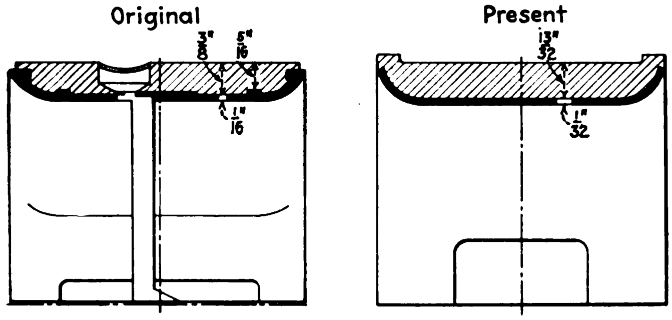


Fig. 9—Changes in design of connecting-rod crank bearings which have increased the service life of the bearings—These bearings are for an engine with the following characteristics:

Diameter of crankpin, in.	4.75
Original effective length of crankpin, in.	2.043
Original projected area of connecting-rod crank bearing, sq in.	9.7
Pressure, lb. per sq. in., gas load only	4,400
Pressure, lb. per sq. in., gas inertia	3,560
Rubbing speed, ft. per sec.	16.5
Number of bolts in crank end of connecting rod	2
Capacity of lubricating-oil pump at 800 r.p.m., gal. per min.	34.1
Number of cylinders	6
Engine speed, r.p.m.	800

tures of 250 and 300 deg. F. The tinning bath is composed of babbitt containing 70 per cent tin and 30 per cent lead solder, maintained between temperatures of 600 and 650 deg. F. Considerable care is exercised in maintaining the babbitt pot at 1,050 deg. F., and the molten metal is poured from a ladle previously raised to the same temperature. This ladle is of a large size enabling a complete pour to be made in one operation. The shell is not removed from the jig until it has cooled to 225 deg. F.

During the tinning process the shell is completely immersed in the bath and left until it has reached a uniform temperature, being removed to coat it with soldering flux. This, briefly, is the practice employed during the process and great care is exercised to insure cleanliness and accuracy.

The rough hammer-and-chisel maintenance methods credited to the railway organization no doubt caused unnecessary failures, but this same method applied to the babbitt of the big-end bearing resulted in a test definitely proving the degree of adherence between the babbitt and shell. When this chipping test showed that there was no tendency for the babbitt to peel away from the shell, an almost perfect bond existed between the two metals. The feature since that time has been only the reproduction of the conditions under which this satisfactory bonding occurred, and in this respect the human element plays an important part. There is now only an occasional bearing which shows trouble on inspection, and the average life of these is well above 100,000 miles. Most of the engines go from shopping to shopping without renewal.

In the manufacture of bearings, certain slight changes were found beneficial. These are illustrated in Fig. 9 and show the details of a bearing which was one of the worst offenders, together with particulars of the working conditions. Fig. 9 shows the original design and the improvement which has been in successful operation for several years. Anchor grooves and oil grooves were eliminated and the babbitt thickness has been materially reduced. Oil pockets were cut at right angles to the rod center line and end collars have been added.

Bearings of 4¾ to 5 in. diameter are installed with only 0.001 to 0.002 in. clearance, and operate at normal temperatures with clearances of 0.003 in.

General

A certain amount of distortion is found in the main-bearing openings of the crankcases after several years of service. However, the practice of line reaming the main bearings in place, which has been adopted, takes care of this. The slight differences in babbitt thickness which results from this practice is of no consequence. The same type of bearing is used in the mains as in the connecting rods previously described. Extremely long life is obtained from these. However, in the ordinary course of events they are renewed at each general overhaul when the crankshaft is reconditioned. In other words, these bearings do not wear out but are replaced with bearings of smaller size to accommodate the reconditioned shaft.

The reconditioning of aluminum cylinder heads with steel valve seats has presented no problems uncommon to automobile engines. Occasionally a head will become bustion-pressure area, it is repaired by welding. A 50-lb. hydraulic test of the water space is made following such repairs. Reaming of the seats is required at periods of 100,000 miles. Exhaust-valve guides also require renewal at this period.

The four-cylinder engines have been practically free from any renewal of parts in the gear cases in spite of mileages around 500,000. On the six-cylinder engines,

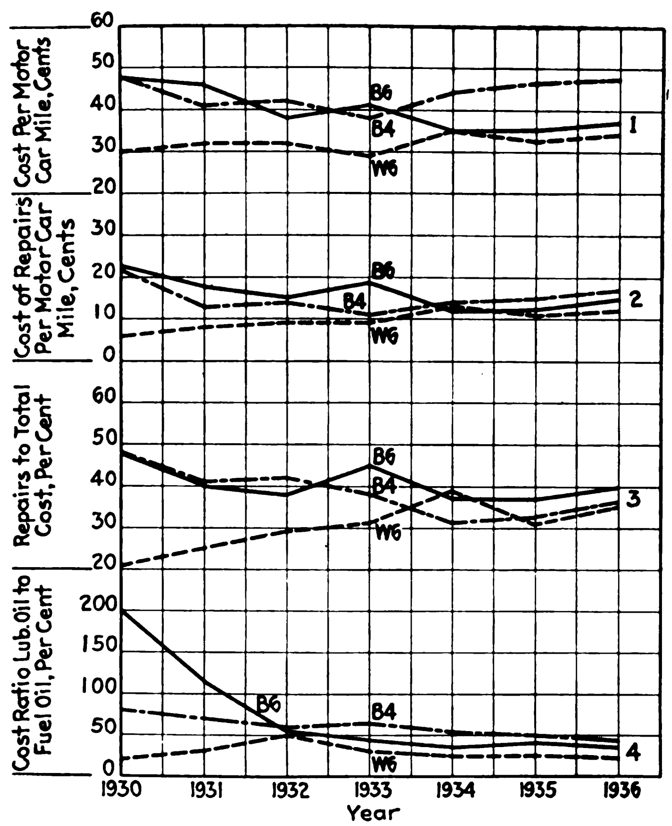


Fig. 10—Cost per car mile for Diesel-electric operation

During the period shown in this figure the engines were operated an average of 192 miles per day—The letters on the curve refer to Beardmore four- and six-cylinder and Westinghouse six-cylinder engines

however, this unit becomes noisy at about 150,000 miles and will require renewal of gear-case parts at 200,000 miles. It is likely that the difference in torsional vibration is responsible for this, and on some occasions it has been noted that early trouble with the gears was associated with an improperly adjusted vibration damper.

The type of wrist pin with which these engines are fitted, which is free to revolve both in the piston and the bearing, is very easy to maintain. It is only in the last few years that they have required any attention. Wear of 0.006 in. is the maximum which has been found even after many years operation. This is rather surprising as the loads on this part are high. The wear on wrist-pin bosses in the piston and also in the rod bushing is relatively low, and the only measure which has been taken to regain the original clearances on worn parts is in providing 0.005 in. oversize pins by means of chromium plating.

Fuel-injection pumps and atomizers are sent in to a central repair shop which is adjacent to a toolroom equipped to make adequate repairs. Plungers and valves are reduced in diameter 0.003 and 0.005 in. as required, and new bushings are fitted. Considerable technique has been developed in this work, and lapping of the parts which at one time was a tedious job has been cut to a minimum. Each pump unit is given a static test of 5000 lb. pressure as an initial check for leakage. The completed pump is put on an operating test and the fuel quantities balanced using the atomizers which are to be installed with it.

Governors, lubricating-oil pumps, water pumps, and primary fuel-oil pumps operate over 200,000 miles between shopping periods without trouble. Often these will go to the third general overhaul before requiring much attention. Two or three spare units of each type have been provided for protection and are handled similarly to pistons and liners, being repaired at a central shop and sent to outlying repair points as occasion demands.

Some further impressions of the average mileage which is being obtained from various engine parts under the maintenance practices which have been described are shown in Table IV. This also shows data relating to the limits of wear which are in effect.

Further details of the more important factors pertaining to the cost of maintenance are included in Fig. 10 for years 1930-1936. The average trend of total cost per mile, shown in curve 1, has been downward to 1934 and has held between 36 and 40 cents per mile since then. One of the greatest influences on total cost is total miles and, unfortunately, as a recent of alterations in train schedules, the runs which have been operated by this equipment are shorter than previously. At one time groups of these cars were on runs of 300 miles per day and this dropped to 220 miles in 1929 and has made a further drop of 13 per cent since. The fact that repair cost has held constant, or been slightly lowered, as shown in curve 2, in spite of this, is very gratifying. It has been impossible to obtain the cost of engine repairs separate from the other mechanical and electrical repairs. However, the fact that there has been a general improvement in this is seen from curve 3, which gives the repairs in per cent of total cost. Last, but not least, in curve 4 is shown the very satisfactory reduction in lubricating-oil consumption which has resulted from a systematic handling of pistons and cylinder-liner repairs.

Table IV—Maintenance Practice of Diesel-Engine Parts

Part	Limits of wear	Average mileage	Type of repairs
Crankshaft	0.006 in. out-of-round on two or more crankpins	250,000	Recondition
Cylinders	Worn between 0.045 and 0.06 in. on diameter	150,000	Recondition
Pistons	Worn 0.01 in. above top ring; 0.006 in. clearance in three ring grooves; 0.005 in. clearance in wrist-pin hole	100,000	Recondition
Connecting-rod bearings	Clearance maintained between 0.003 in. and 0.004 in. by adjustment of shims	No record of worn out bearings	
Wrist pins	Worn 0.006 in. on diameter	300,000	Renew
Exhaust valves	Renew when bent, warped, or stem worn 0.005 in.	75,000 200,000	Grind Renew
Exhaust-valve guides	Renew when worn 0.008 in.	100,000	Renew
Piston rings	Gap opening increased to ⅛ in.	75,000	Renew

Some ideas on depreciation of Diesel-engine equipment can be gained from our experience. In the first place the results after 12 years with the oldest engines indicate that an estimated life of 20 years is conservative. The possibility of engines of this type becoming obsolete or the costs rising to where they are uneconomical after extended service is remote. By inexpensive investigation, it is possible during overhaul to improve and modernize the engines, even within the narrow confines of existing crankcases, with beneficial results. Finally, by careful records of wear being kept, a systematic handling of repairs can be set up which results in a lowering and stabilizing of engine-repair costs. Up to the present it would appear that depreciation is practically taken care of by renewal of the active parts.

* * *

Application in Car Construction of

High Tensile Steels*

By A. F. Stuebing†

Simple precautions for welding and forming high-tensile steels —Economies possible by their use in the rebuilding of cars

The proceedings of one of the earliest meetings of the Master Car Builders' Association record that in 1871 that organization passed a resolution calling on the railroads to build light-weight freight cars for experimental purposes. However, it seems that the car builders found the design of a practical light weight car a difficult problem and not one was constructed during the following year.

It is interesting to know that even sixty-six years ago car-department officers realized that the weight of cars was a major factor in economical railroad operation. In later years, substantial progress in weight reduction was effected by the use of stronger materials and by refinements in design. Recently, this problem has again assumed increasing importance due to changing operating conditions. In 1920, the ton miles of dead weight and of pay load which the railroads hauled in freight trains, excluding the locomotive and tender, were approximately equal. In recent years, the dead weight has been about one and one-half times as much as the lading. In passenger service, the need for light-weight equipment is self-evident to permit economical operation at the high speeds that are now being adopted for a large proportion of the through trains. Ralph Budd, president of the Chicago & Quincy, has stated that, if the weight of all passenger and freight cars in this country could have been reduced by one-fourth, the saving to the railroads in 1937 would have been $154,000,000.

Fortunately, the railroads now have available a practical means of effecting the reduction mentioned by Mr. Budd. It can only be done gradually as new equipment is obtained or cars are rebuilt, but a good start has already been made. In the last three years, over 16,000 freight cars and 600 passenger cars have been built of a new type material especially adapted for car construction—namely, high tensile steels.

Characteristics of High-Tensile Steels

Before proceeding to discuss the application of these materials, it may be well to outline in a few words their salient characteristics from the standpoint of car construction. Briefly stated, the high-tensile steels are a new group of materials which, as-rolled, without any special treatment, provide a combination of high tensile strength and ductility previously available only in heat-treated steels. Most of these materials can be readily welded by the autogenous process. Some possess superior resistance to atmospheric and other kinds of corrosion to which car equipment is subjected.

All of these high-tensile steels cost more per pound than mild steel, but some now cost no more per unit of strength. However, the unit price of the material is often a minor factor, as is shown by the fact that light-weight high-tensile-steel freight equipment, designed to provide strength and life equal to conventional cars, costs no more per ton of capacity.

The savings that can be effected by reduction in the weight of cars have been discussed in detail in several papers. It has been pointed out that high-tensile steels can be used for increased strength and lower maintenance on the one hand, for weight reduction and savings in operating expenses on the other, or in a compromise between the two objectives.

In the majority of cases, the objective sought by the application of high tensile steel will be reduction in weight, in order that more efficient load ratios may be achieved with consequent operating economies. These savings usually far out-weigh considerations of reduced maintenance and added life beyond the normal term of conventional equipment. Most designs of railroad equipment use high-tensile steels conservatively. Such cars provide greater strength, in addition to better load ratios, and will have lower maintenance cost and longer life.

The physical properties of high-tensile steels adapt them for use in types of equipment which must withstand unusually severe service, such as mill-type gondolas, mine cars and dump cars. Even in the case of such equipment, it has been found practical to make some reduction in weight by decreasing sections in many parts of the car structure.

Design Considerations

The application of high-tensile steels requires changes in practice and introduces some new problems in design and construction. It is often difficult to escape the idea that bulky members are necessary for strength. The opinion has been expressed that center sills, because they are subjected to severe shock, should have sections approximately equal to those used in standard constructions, even when built of high-tensile steel. Certainly any one who recalls the troubles caused by some of the early applications of light-weight center sills, many without cover plates, made about thirty years ago, and the excessive repair costs which they entailed, will agree that it is important to have adequate strength in the underframe construction of any car. However, if the strength required to withstand the maximum forces can be obtained with relatively smaller cross-section area, such a construction is advantageous. Draft-gear tests, conducted by actual car impact, have demonstrated that the resiliency inherent in the car structure is an important factor in supplementing the capacity of the draft gear. The greater the amount of this resiliency, the lower will be the ultimate force in a given impact. Consequently, the use of a smaller cross-section of a material adapted to withstand higher unit stresses will result in added protection to the car, provided the maximum strength of the center-sill construction is adequate.

Questions frequently arise regarding the reduction from the thickness or cross-sectional area of carbon-steel parts that is permissible when high-tensile steel of certain known physical properties is used. No simple rule

* Presented at the Convention of the Car Department Officers' Association held in Chicago, Wednesday, September 29, 1937.
† Railway Mechanical Engineer, United States Steel Corporation.

can be given for determining the proper reduction for all applications. If members are used in direct tension so that the stress varies directly with the cross-sectional area, the section used may be in the inverse ratio of the permissible stress; for instance, if the unit stress is increased from 16,000 lb. per sq. in. for carbon steel to 24,000 lb. per sq. in. for high-tensile steel, or 50 per cent, the area of high-tensile steel required in tension will be two-thirds the area of carbon steel and the reduction in area and weight will be 33 per cent. However, the conditions will be quite different in a flat plate subjected to bending, as in a car floor. Here the strength varies as the square of the thickness and, if the thickness is reduced 33 per cent, the strength is reduced 55 per cent. In that case, the unit stress, instead of being 50 per cent more, would be increased 125 per cent. Because of this relationship, designers of high-tensile steel equipment have, in some cases, used corrugated or buckled sheets, or have reduced the unsupported area of flat panels.

Similar problems are encountered in the design of columns, girders and other elements of car structures. However, the basic principles for the proper application of the high-tensile materials have been developed and provide a sound basis for reliable and economical design.*

The protection of cars from corrosion deserves careful consideration, irrespective of the type of material used. Investigations have proved that atmospheric corrosion is chiefly responsible for the deterioration of railway equipment. Hence, in the selection of steel to withstand corrosion in cars, the most important factor is the resistance of the steel when exposed to the atmosphere. It is true that the most rapid corrosive attack occurs when destructive leachings are produced by coal or other commodities. None of the metals available for car construction offers adequate resistance to the action of contact corrosion under these conditions. Cars can be built to resist atmospheric corrosion and to give satisfactory life under normal service conditions, but it is impractical to design them to withstand the abuse which they sometimes receive when used as storage bins. However, every practical means should be adopted to protect freight cars by making them self-clearing and by eliminating laps and seams in which dirt and moisture may be retained. Marked improvement can often be made by minor changes, such as locating parts so that they will drain off an overlapping edge and not into a seam, or by welding to form an integral construction. Repairs necessary because of mechanical damage in present-day designs of freight cars have been reduced to a minimum; hence, attention to such details as are mentioned above is important to produce a similar increase in resistance to lading corrosion.

Forming Characteristics of High-Tensile Steels

From the standpoint of shop facilities, the introduction of high-tensile steels need cause little concern. Although these materials are stronger and therefore require more power than carbon steel when working with equal sizes, the thicknesses applied are usually decreased to such an extent that they can be formed and fabricated without exceeding the capacity of machines used for similar operations on carbon steel. It seems advisable to call attention to the fact that the manufacturer's rating for shop machinery is generally based on mild steel, and the maximum size for which a machine is rated will not apply to the stronger high-tensile steels. If machines are working near the limit of their capacity, it is advisable to give special attention to the condition of punches, dies and shear blades. Keeping tools sharp and in proper alinement will do much to prevent excessive loads.

In forming and fabricating high-tensile steels, it is always advisable to follow the instructions issued by the manufacturer. The variations from practices generally used for carbon steel may be slight; nevertheless, they may be responsible for the success or failure of the operation. When shops first undertake to work these materials, some important precautions are frequently overlooked, and it seems desirable to mention them here.

Pressed parts should be formed with somewhat larger radii than are commonly used with carbon steel. Some members which are ordinarily formed cold may need to be pressed hot when high-tensile steel is used. All parts made of high-tensile steel should be shaped to match closely before they are fastened together. It is not advisable to pull sections into place forcibly, because the material has considerably more spring-back than plain carbon steel and the structure is likely to be distorted due to trapped stresses. High-tensile steel will not compress in forming operations to the same extent as mild steel and will tend to fold over at pressed corners. To remedy this condition, the blank should not be cut in the normal manner on a radius to give a constant height of flange, but on a diagonal which will reduce the height of the flange at the corner. If preferred, a square notch may be cut out of the corner and the edges welded after pressing.

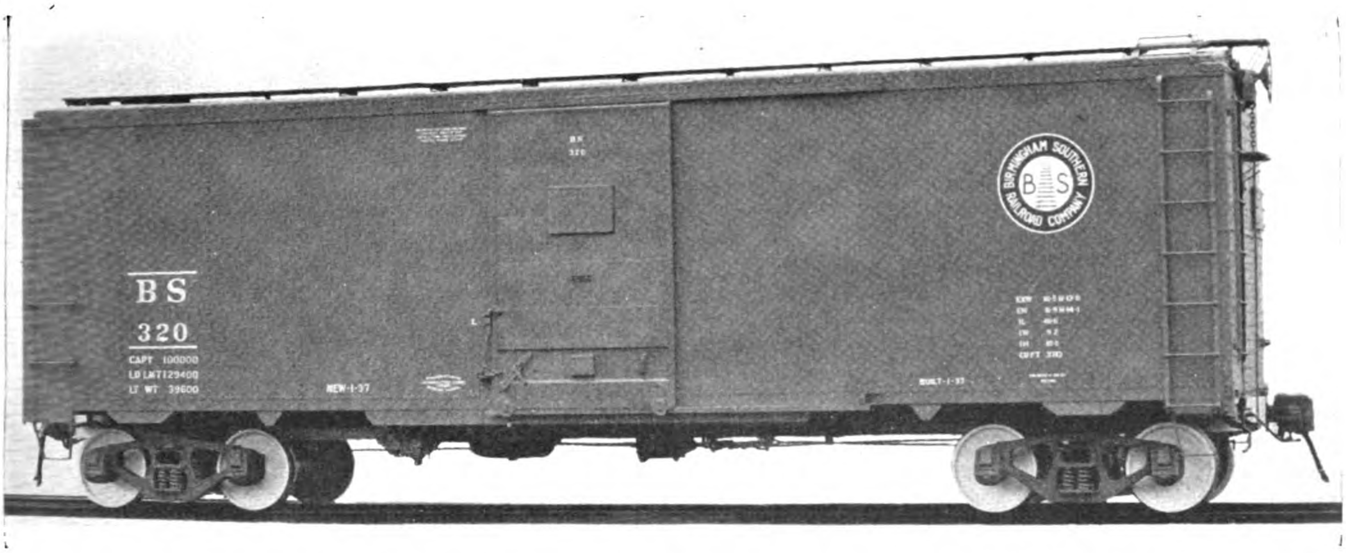
In working with high-tensile steel of low alloy content, proper control of temperature is generally more important than with carbon steel. It is advisable to avoid working either carbon steel or high-tensile steel at temperatures between 300 deg. and 1,000 deg. F. Furthermore, steel should not be held at temperatures within this range longer than necessary. Heating above the proper normalizing temperature for the particular steel in use should also be avoided.

Weldability Depends on Analysis of the Steel

The weldability of high-tensile steel is extremely important, because welded construction permits reduction in weight, and avoids overlapping seams and joints. It also obviates the necessity for the additional rivets required for thin sections, and thus lends itself to most effective and economical utilization of these materials in car equipment. The adaptability of the different compositions of high-tensile steels varies widely. Because of this, it is necessary to know that the particular material used in a welded structure is suitable for the process to be applied. For instance, the operation of spot welding consists of melting a small amount of the metal and then cooling it almost instantaneously through the critical temperatures. If the steel contains a considerable proportion of hardening elements, a region in or around the spot will be made hard and brittle by this process and the weld will have low resistance to shock and reversed stresses. The values of pressure, time and current giving the best results in spot welding are not the same for all steels. In a car structure, it is necessary to have welds possessing ample strength and endurance; therefore, the welding-machine setting should be adjusted for optimum results as determined by physical tests of specimens, and not merely for any combination of factors that will give a reasonably strong weld.

The methods of metallic arc welding used for high-tensile steels are ordinarily about the same as those used in welding carbon steels in connection with high-strength electrodes. It is unwise to use uncoated electrodes, which will deposit brittle metal of low strength. If this is done, the weld will be much the weakest part of the structure.

* See articles entitled Designing for High Tensile Steels, by H. M. Priest, published in the *Railway Mechanical Engineer*, May and June, 1936.



Welded underframes were used in 100 Cor-Ten box cars for the Birmingham Southern built by Pullman-Standard Car Manufacturing Co.

Where mild-steel electrodes are used for welding steel containing alloying elements, some of the melted base metal is mixed with the deposited metal, thereby increasing the strength of the weld. The extent to which mixing takes place depends on the type of joint, number of layers, and composition of the base metal. Due to this action, coated mild-steel electrodes often produce welds of satisfactory strength and excellent ductility. Such electrodes may be used except in some cases where the thickness of the weld cannot be more than that of the base metal and 100 per cent efficiency is required.

Fabricators have experienced some difficulty in avoiding buckling of the panels of welded high-tensile steel equipment. This trouble is due primarily to the thinness of the sheets, rather than to their added strength. Such buckling does not impair the strength of the equipment, but it detracts from a pleasing and workmanlike appearance. Careful designing will help the shop to avoid a wavy appearance in the sheets. An effective measure is to reduce the size of the panels, or they may be broken up into smaller sections by corrugations, which will also add stiffness. If neither of these methods is practicable, another alternative is to have every large smooth surface curved slightly.

Attention to minor details in the shop will help to insure satisfactory appearance in the finished car. The framework on which the sheets are supported should be in good alinement, with no irregularities in the surfaces to which the sheets are fastened. A slight wave or kink, which would not affect a heavy sheet, may cause a buckle in a thin sheet. In welding operations, distortion can best be prevented by tacking the sheet at some neutral point, and then working away from it in opposite directions.

Shop Practice Presents No Serious Difficulties

To avoid the impression that shop practice for high-tensile steel involves serious difficulties, it should be said that many fabricators have reported that such material gave no more trouble than mild steel. A good example of the satisfactory manner in which high-tensile steel has been applied is the case of the Victorian Railways of Australia. When this road first built a high-tensile-steel passenger train, no technicians familiar with the working of these materials were present and only general instructions regarding shop practice were available. The Chairman of the Victorian Railways reported:

"No difficulty whatever was experienced in the fabrication and assembly of the Cor-Ten-steel parts. The work has included welding, forming (hot and cold, but mainly cold), drilling, riveting, etc. Our experience was in accordance with the advice you gave us regarding the special allowance necessary for greater spring back, and this had already been taken care of in the design of the forming blocks.

"Shearing and riveting entailed no more difficulty than is normally experienced with commercial mild steel. Greater precision was, of course, required because of the lighter-gage material. Similarly electric arc welding by Cor-Ten electrodes did not present any difficulty."

Rebuilding with High-Tensile Steels

The accomplishments of the railroads and car builders, through the use of high-tensile steel for both new and rebuilt equipment, are noteworthy. You are, no doubt, familiar with much of the new equipment, but it may be of interest to describe briefly an ingenious method of increasing capacity adopted by one railroad. The hopper-car traffic on this road consists principally of coal, ore and coke. Because of the need of large cubic capacity for hauling coke, cars of 70 tons nominal capacity, 42 ft. long weighing 54,900 lb. and carrying 3,400 cu. ft., were assigned to this service. Another group of cars consisted of 520 50-ton hoppers, 32 ft. long having cubic capacity of 2,120 cu. ft. and weighing 41,000 lb.

Since the 70-ton cars, when loaded with coke, utilized only 65 per cent of the allowable weight capacity of the car and developed a total weight on rail of but 155,000 lb., a study was made to determine the feasibility of improving the ratio of pay load to tare weight by using high-tensile steel construction. As a result of this study, the railroad decided to rebuild the bodies of 520 70-ton cars, using corrosion-resistant high-tensile steel which would permit a substantial reduction in weight, and to mount these bodies on 50-ton trucks. The volume of the body was increased to 3,925 cu. ft., or 15.5 per cent, and the weight of the car was reduced to 41,900 lb. The ratio of pay load of coke to tare weight was increased from 1.82 to 2.92. The trucks required for these bodies were taken from the 520 hopper cars of 50 tons capacity. The bodies of the 50-ton cars were reinforced to provide sufficient strength for 70-ton loads, and were then mounted on the 70-ton trucks. In this

manner, the capacity of these cars for hauling ore was increased 17.6 per cent. Thus the rebuilding of the 520 cars was equivalent to adding 81 cars for coke and 143 cars for ore, yet the expenditure, including the added cost of the steel and labor, was only five per cent more per car than the cost of repairing in kind with copper steel, which would have left the cars unchanged and would not have afforded the benefits of increased capacity and more favorable load ratios.

The example cited above illustrates the possibilities of improvements to existing cars by applying high-tensile steels either in the complete car body or in individual parts. Frequently such changes can be made with resulting savings in interest, depreciation and maintenance, especially where, as in this case, the number of cars required to handle a given traffic can be decreased. In this instance, as in the majority of installations of high-tensile steel equipment, the operating aspects are most important. The largest saving produced by reconstructing these hopper cars is estimated to be the reduction in the net out-of-pocket cost of transportation. This again emphasizes the fact that the cost of hauling the dead weight of freight cars is usually greater than the cost of maintaining them. In all, the railroads spend annually over one and one-quarter billion dollars to provide and transport freight cars. This is an indication of the magnitude of the responsibility of the car-department officers, because these expenses are either directly determined, or largely influenced, by the types and characteristics of freight and passenger cars.

The producers of rolled steel introduced high-tensile materials, but it was necessary for the car builders and railroads to adapt them to light weight equipment as a means for improving the efficiency and economy of railroad transportation. The numerous and extensive installations of such equipment, only three years after the material which made them possible was introduced, are evidence of the initiative, resourcefulness and enterprise of the officers of the car department and the railroad organizations which they represent.

The Effect on Locomotive Boilers of

Pitting and Corrosion*

J. L. Callahan†

Results of corrosion-research experiments with feedwater of various analyses—The effect of alkalinity on corrosion discussed

A great deal has been written on the effect of alkalinity in boiler waters on corrosion. For the first time the results of a comprehensive series of experiments have been brought together for publication.

By alkalinity is meant the total carbonates and hydrates as obtained by titrating the water with an acid using methyl orange as the indicator. The prime purpose of adding alkalies to boiler feed water is to prevent the formation of hard scale so that most boiler waters carry alkalinity to some extent. Most feed waters have dissolved sulphates and chlorides, which concentrate in the boiler as dissolved salts. These salts together with the carbonates and hydrates and small amounts of other inorganic and organic matter constitute the dissolved solids. The dissolved solids are determined by evaporating a sample of boiler water and weighing the residue, or by using an electrical instrument.

There are several methods of expressing the alkalinity. The most common method is to state the total alkalinity as determined in the presence of the methyl orange indicator. Because of the difficulty of using methyl orange, other indicators are used. One of the easiest to use is phenolphthalein. However, this indicator will only show, in most cases, 85 to 95 per cent of the total alkalinity depending somewhat on the feed water used and the pressure. Others prefer to express the alkalinity as a percentage of the total dissolved solids. For example, if the total alkalinity was 20 and the total dissolved solids were 200, the per cent alkalinity would be 10.

Some excellent work has been done on corrosion, and one of the finest pieces of research was done by Commander Lyon for the Navy.** His general conclusions were (1) small amounts of alkali slightly retard corrosion, (2) increasing amounts increase corrosion until a maximum rate of corrosion takes place, and (3) further additions of alkalies decrease corrosion until at high concentrations of alkali no further corrosion takes place. Commander Lyons also found that all alkalies do not have the same effect.

With low chloride content he found that 50 grains per gal. of hydrated lime, 80 grains per gal. of soda ash, 61 grains per gal. of caustic soda, 110 grains per gal. of disodium phosphate, 13 grains per gal. of sodium chromate and 10 grains per gal. of sodium dichromate were required to stop corrosion. However, with more than 25 grains per gal. of sodium chloride present no amount of lime, chromates or dichromates would stop corrosion.

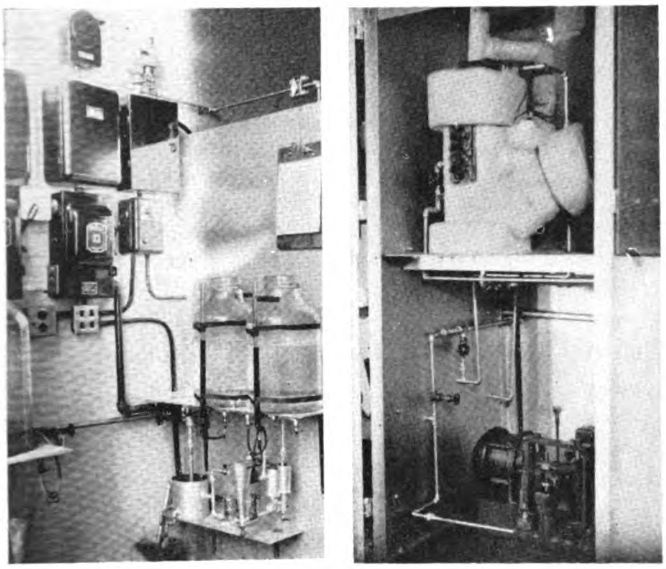
Commander Lyons also concluded that maximum corrosion occurred with 25 grains per gal. of soda ash or 19 grains per gal. of caustic soda, or 33 grains per gal. of disodium phosphate.

Experiences have differed on the effect of alkalinity. In many cases no corrosion or pitting has been experienced on railroads where alkalinities were maintained at a rather low value. In other cases railroads have had pitting at low and moderate alkalinities, and in some cases it has been found that excessively high alkalinities are required to prevent pitting. Because of these varied experience several series of experiments were conducted to find the effect of alkalinity.

* Presented at the Convention of the Master Boiler Makers' Association held in Chicago, Wednesday, September 29, 1937.
† Service Engineer, National Aluminate Corporation.
** "Corrosion of Boilers and of Piping on Ship Board," by Commander Frank Lyon, Journal of the American Society of Naval Engineers," vol. 24, 1912, p. 845.

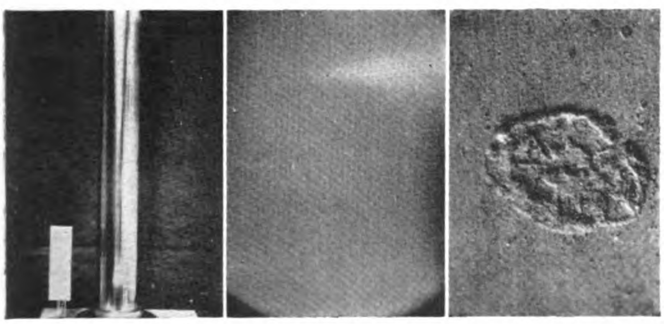
The tests were made in boilers operating at 250 lb. per. sq. in., using feedwater at the rate of 1 gal. per hr.

The experimental boilers hold 0.8 gal. at normal water level. Each consists of a vertical drum to which is attached the external heating section and return circulation tube. The heat is supplied by a suitable electrical heating element placed inside a boiler tube 12 in. long, which in turn is held securely inside the heating section.



Test apparatus. Left: Boiler and feed pump. Right: Feedwater storage and controls

A boiler tube can be withdrawn and inspected for scale and corrosion at the end of a test as the outside of the boiler tube is the water side, corresponding to a fire tube. The heating section and boiler tube are inclined upward from the bottom of the drum at an angle of 30 deg. from horizontal. The circulation tube returns steam and water from the upper point of the heating section to the drum. By this means circulation of boiler water is obtained. The feedwater enters just below the waterline. Blowdown is taken 2 in. below the surface.



Left: Boiler tube ready for use. Center: Surface of clean boiler tube. Right: Tube corrosion with Alkalinity = 20, dissolved solids = 103

These boilers are operated by automatic devices which control the feedwater pumps, pressure, preheater temperature, blowdown rate, and evaporation rate at any setting desired.

The feedwater in all cases carried over 5 cc per liter of oxygen and was not preheated. In order to eliminate experimental errors while the boiler water was building up to concentration, the tests were made on boiler water which was carefully preconcentrated to the desired value.

These tubes were made of standard 10-20 class A boiler-tube steel by welding a flange at one end and a plug in the other end, after which mill scale was removed by grinding with a final working of medium emery paper.

There are a great many factors which influence corrosion, but the purpose of this whole investigation was to find the effect of alkalinity alone when no other factors such as scale, organic matter, protected surfaces, or oxygen absorbents would interfere.

The first series of tests was made using a feedwater having the analysis of hardness = 0.0, total alkalinity = 3.2, chlorides = 4.3, sulphates = 8.5 and oxygen = 5.5 cc per liter. This feedwater was chosen as being similar to water where corrosion was being experienced.

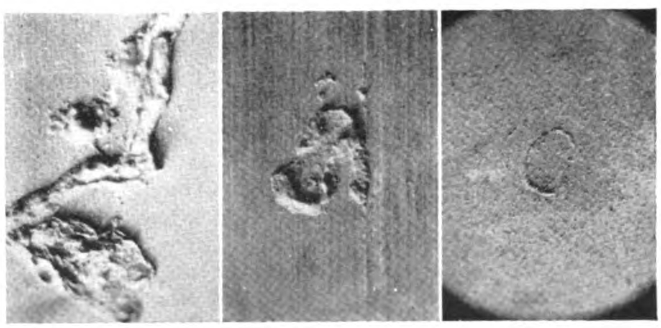
Table I—First Series of Corrosion-Research Experiments

Boiler Water Analysis						
H	P	M	Cl	SO_4	D.S.	Remarks
0.0	8.9	10.9	13.1	22	48	Considerable general corrosion and some pitting
0.0	18.0	20.0	28.0	54	103	Considerable general corrosion and pitting
0.0	33.0	36.0	44.0	83	161	Considerable general corrosion and some pitting
0.0	43.0	46.0	59.0	112	221	Considerable general corrosion and some pitting
0.0	53.0	57.0	83.0	164	318	Some general corrosion and some pitting
0.0	58.0	64.0	88.0	174	325	Some general corrosion and considerable pitting
0.0	67.0	69.0	100.0	193	371	Considerable general corrosion and pitting
0.0	73.0	81.0	110.0	203	406	Considerable general corrosion and some pitting
0.0	82.0	89.0	122.0	234	448	Some general corrosion and pitting
0.0	95.0	104.0	141.0	272	522	Some general corrosion and pitting

A feedwater alkalinity of 3.2 was used as this resulted in a boiler water having an alkalinity approximately 20 per cent of the dissolved solids.

Tests were made at ten different concentrations, with analyses and dissolved solids varying between 48 and 522 grains per gal., as given in Table I, in order to cover as wide a range of conditions as possible.

The general conclusions of this series of tests are (1) that an alkalinity of 20 per cent of the dissolved solids does not prevent corrosion, (2) that at low concentrations general red corrosion predominated, and (3) that at high concentrations pitting predominated.



Tube corrosion. Left: Alkalinity = 46, dissolved solids = 221. Center: Alkalinity = 104, dissolved solids = 522. Right: Alkalinity = 10.4, dissolved solids = 111

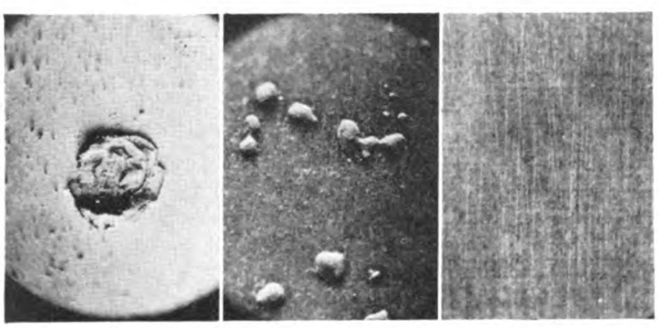
The question then arose as to whether or not any amount of alkalinity would stop corrosion. To answer this question a second series of nine experiments was made with feedwater analyses and total dissolved solids in the neighborhood of 135 grains per gal., as given in Table II, and with the amount of alkalinity in the boiler

water varying between 5 and 90 grains per gal. The feedwater analysis was chlorides = 4.3, sulphates = 8.5 and oxygen = 5.5 cc per liter as in the previous series of tests, but in which the alkalinity was adjusted to get the desired alkalinity in the boiler water.

Table II — Second Series of Corrosion-Research Experiments

Boiler Water Analysis						
H	P	M	Cl	CO_4	D.S.	Remarks
0.0	3.1	5.1	49.9	91	155	Heavy general corrosion and pitting
0.0	7.5	10.4	35.3	63	111	Considerable general corrosion and pitting
0.0	17.3	20.9	31.2	60	119	Decrease in general corrosion, increase in pitting
0.0	27.5	32.7	38.2	69	144	Decrease in general corrosion, increased pitting
0.0	35.8	40.8	27.2	54	125	Further decrease in general corrosion, pitting greatly reduced
0.0	49.9	54.0	26.0	57	134	Little general corrosion, some pitting
0.0	64.0	71.0	20.5	42	139	Very little general corrosion or pitting
0.0	77.0	85.0	17.0	36	143	No pitting
0.0	83.0	90.0	17.0	29	140	No pitting

The general conclusions from these experiments are



Tube corrosion. Left: Alkalinity = 20.9, dissolved solids = 119. Center: Alkalinity = 54, dissolved solids = 134. Right: Alkalinity = 71, dissolved solids = 139

(1) that corrosion and pitting will be prevented if sufficiently high alkalinity is carried, (2) that the addition of alkalinity tends to convert general red corrosion into pitting, and (3) that alkalinity will prevent general corrosion before it will prevent pitting.

With alkalinity of 85 and dissolved solids of 143 there was no corrosion or pitting. Good results were also obtained with an alkalinity of 71 and dissolved solids of 139.

These two series of tests brought out a number of interesting points, but it was felt that the investigation should be broadened to determine the amount of alkalinity required over a wide range of conditions.

Further experiments were carried out much in the same manner as the previous experiments. The feedwater analysis was chlorides = 4.3, sulphates = 8.5, and oxygen = 5.5 cc per liter. In addition, sodium carbonate and caustic soda were added in equal parts to maintain the desired alkalinity in the feedwater.

This group of experiments consisted of six series. In each series the amount of chlorides and sulphates in the boiler water was held constant. The boiler water alkalinity was low in the first experiment of each series, and raised gradually with each succeeding experiment until more than enough alkalinity had been added to stop pitting. The results were consistent throughout, but each series of experiments was run twice in that portion considered to be the critical range, for complete protection.

One very interesting observation made was that in tests with low alkalinity the tubes were always red. As the alkalinity was increased the red corrosion gradually disappeared, the tube becoming darker and, in many cases, almost jet black. However, pitting persisted until sufficient alkalinity had been added. Those tubes on which corrosion could be found were covered with a jet-black film which was smooth and hard. This film was very thin and served to protect these tubes from atmospheric corrosion. This region is called the critical range.

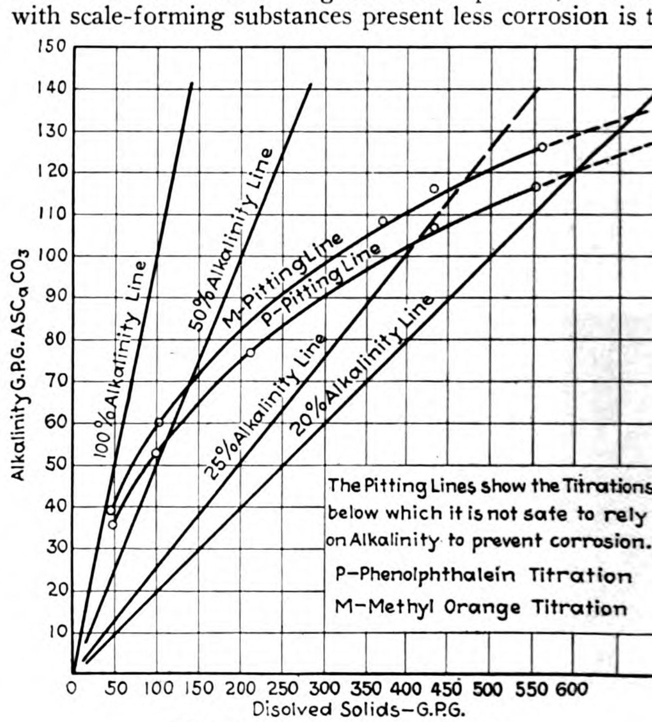
The information obtained from the last experiments would justify the additional conclusions (1) that excessive alkalinity is required to be sure that corrosion does not take place, (2) that as the dissolved solids increase the amount of alkalinity required increases, and (3) that the percentage of alkalinity required is less with high dissolved solids than with low dissolved solids.

The general conclusions obtained from these investigations, as given in Table III, agree with the findings of Commander Lyons, except that our observations do not justify the conclusion that there is a maximum corrosion rate at alkalinities of 19 to 25 grains per gal.

Table III — Conclusions of Corrosion-Research Experiments

Dissolved Saline Salts, Grains per Gal.	Alkalinity, Grains per Gal.	
	Corroding	Non-Corroding
0	36	39
40	58	61
125	78	84
260	104	108
310	106	116
420	118	126

This may be explained on the basis that our tests were made without scale-forming substances present, whereas with scale-forming substances present less corrosion is to



Alkalinity as a corrosion preventive

be expected at low alkalinity where the tubes will be covered with scale than at higher alkalinities where the tubes will not be so well protected by scale.

Field observations have tended to substantiate the findings presented here.

The author acknowledges the cooperation of Dr. P. G. Bird, Research Director of the National Aluminate Corporation, under whose direction these experiments were conducted.

Factors Influencing the

Future of Transportation*

By L. K. Sillcox†

Experience of past interpreted in relation to modern conditions—The direction of future railway expansion discussed

We have come to be a nation whose industrial enterprise, and every department of national solidarity and national life are so closely associated with transportation that the two are vitally interdependent. In the past twenty years, and particularly during the past decade, we have witnessed a remarkable change—one which has been of real benefit to the nation but scarcely so to the railways. Competition has arisen and projected itself into the business of transport with no rational plan and, for the most part, with no responsible guidance. The result has been a tremendous transport upheaval, with competitors striving to broaden the wedge which has been driven ever deeper into an expanding traffic volume and the railways fighting to arrest the trend with every familiar weapon.

The private automobile and truck on the highway have been most active in creating this transport revolution. The railways, with the experiences of the recent past freshly in mind, can ill afford to permit the airway a strong foothold, without challenge, on so much as the fringe of mass transport.

New Standards of Speed and Comfort

The public has been educated to expect that which it demands and it will be served. Forty and fifty years ago the railways demonstrated their capacity for high speed passenger service yet it is, for the most part, isolated runs which are recorded.

From this time forward we may look to no new accomplishments in speed which will not be widely patronized and progress in one territory must be immediately simulated in every other. The railways must provide these accommodations or surrender the traffic. With the general taste for speed comes the present clamor for comfort—comfort in freedom from jolts and bad starts—comfort in temperature and humidity—comfort in deep and restful upholstery of well proportioned seats—eye comfort in the coloring of interior decoration and well directed lighting—and comfort in stopping from whatever high speed may be operated in a distance which is consistent at once with high scheduled speed, the ultimate accomplishment in safety, and comfort.

Given the best of modern tools with which to work, the engineman at the throttle and brake valve and his supervisors are the men who bear responsibility of maintaining railway standards of passenger comfort. Colors and fixtures are inert appointments which are or are not acceptable when the car is released. Air conditioning must be automatically adapted to the average taste before it can be considered fully developed. But a locomotive and its train constitute a live and dynamic entity, responding to the expert hand of the man in the cab and the value of all fine appointments are forfeited if he is either careless or has not received the careful training which is essential for the complete understanding of the equipment he controls. This knowledge of function and operation are indispensable to the proper and economical performance of his duty.

It must not be supposed that ultra-high speed trains will not show economic justification. It has been increasingly realized, during the past few years, that the railways possess a valuable asset in being able to offer high-speed transport combined with an exceptional degree of safety and reliability. Record performances of air travel, racing automobiles, and ocean-going liners have all had a profound influence on design; and it is beyond dispute that the movement towards considerably higher speeds on railways has not only resulted in increased capacity for sustained high speed, but has advanced thermal efficiency at the same time to such a degree as will ultimately benefit all classes of locomotives similarly and the psychological effect on railway personnel of the presence on the line of these high-speed trains is considerable. The fact that they must not in any circumstances, be delayed, smartens up the handling of all train movements, the irregular or more indifferent treatment of which might react upon the new services.

The spectacular in railway achievement, such as the appearance, the speed, and the comfort of these newer trains, cannot be despised in the influence that it exercises on the mind of the public. Public patronage is, after all, the only sure element on which these developments of railway enterprise can be built, and we are certain that newer high-speed service of the character now being offered, in the attention that it directs to the combination of speed, safety and comfort afforded by modern railway travel, will prove to be well worth the cost and effort it involves.

A New Basis for Rates Needed

There is also to be considered the recurrent demand for railway freight rate and passenger fare reductions—scarcely compatible with increasing costs but none-the-less real and requiring the efficient accomplishment of the ultimate in operating economies. Since the railway transition from a monopolistic to a highly competitive industry in the last twenty years, dependence upon a level of popular rates and an appealing character of service has been emphasized.

The railway rate question steadily has grown more involved in its relation to the balance of transport values with each step in the broadening field of transport competition until the intricacies of the problem itself now challenge the complexities of the railway rate structure. Whereas it has been possible, for many years, to adjust railway rates to the value of the commodities to which they apply, thereby enforcing a reasonable relationship between cost to the shipper and value of the service, the motor truck on the highway has quite effectively distorted this relationship. The value of transport to all shippers has become the least cost for which it can be obtained and, where the highway hauler is

* Presented at the Convention of Railway Fuel and Traveling Engineers' Association, held in Chicago, Thursday, September 30, 1937.

† First Vice-President, New York Air Brake Company.

concerned, the rate which he quotes generally bears some definite relationship to the actual cost of the movement.

"What the traffic will bear," a rate making basis of sound economic background in monopoly, can maintain neither its definition nor justification in competition. Railway costs are not easily assigned but they unquestionably constitute a tariff base which must be respected if competitors are not inclined to adopt the railway plan of rate making. The cost of transport by railway can be assigned on some reasonable basis more readily, probably, than as complete a class rate structure for highway operations, embodying all the involved detail of the railway system, could be built up and enforced. The railway rates could never be applied to highway operations with a fixed differential favorable to the highway operations, expecting the motor truck to provide the universal service performed by railway. The motor truck presents a new problem in its general incompetence. Its methods are the more simple and thus, the more readily adaptable to railway use.

Present Trends Influenced by Early Experience

A great deal of diligent study and experimentation marked the innovations in train equipment and train handling methods from the days of the DeWitt Clinton locomotive to the introduction of the two-axle trailing truck. Cars, roadbed, and terminals were no less affected than motive power. The best of the past must be maintained and we can ill afford lightly to dismiss the steps leading to the present claim in the matter of safety.

Modern service presents problems much more complex than their antecedents but they vary only in degree and not in their basic properties. New materials are available but they must be proved by the same standards of suitability which have determined the success of prior constructions. The obsolete American type locomotive exhibited capacity for free running and simplicity which permitted sustained high speeds and minimum attention. The Atlantic type possesses many of its virtues but this design, too, was threatened when heavier trains, resulting more from increased weight per passenger than from greater revenue load carried, were substituted for those which two driving axles could smoothly set in motion. But early railway history taught the desirability of limiting the number of driving axles and railway mechanical officers have not forgotten their early experiences but have reluctantly added axles to main-line passenger motive power to provide the adhesion which trends in train consist compelled.

There is now observed a movement toward the simplified types. Two-driving-axle locomotives, with trailing trucks which are sometimes power equipped, are being built for important passenger runs for the first time in many years. The Mountain type locomotive for passenger work may respond to changes by articulated designs of four driving axles for extremely heavy, fast passenger service, breaking up the rigid wheelbase into two distinct units and duplicating cylinders to retain the high-speed mechanical potentialities of the early American type. Beyond the desire to regain the benefits which the past has demonstrated as accruing from the twin-axle drive are found tendencies in train consist and service permitting fewer axles to meet modern adhesion requirements. The horsepower peak must be developed at higher speed to give economical high-speed performance. Since horsepower is defined as the rate of performing work and is expressed in terms of foot pounds per second, the higher the speed, the lower must be the pounds to be overcome for a given horsepower output, fixed by boiler evaporative capacity. This relationship fixes permissible tonnage at high speed and it is further affected since the pounds factor in the equation relates to train resistance and this, in turn, increases with respect to weight as higher speeds are operated.

A two-axle locomotive can, moreover, be constructed, embodying modern practices, which will be, in many ways, superior to its predecessor of twenty years ago. Higher steam temperatures and higher boiler pressures augment the horsepower capacity of a boiler of given weight and size. This, in turn makes it possible to use auxiliary starting engines successfully on formerly idle axles. Feedwater heaters or exhaust-steam injectors relieve the burden of heat input required for the evaporation of each pound of water while valve gear refinements remove restrictions to the steam flow and provide better distribution. The lighter locomotive is a much more powerful machine than heretofore and its greater power can be applied over a much longer period. All these features of the locomotive itself, combined with operating tendencies and advance in car-building practices, are assisting toward the return of the lighter designs and recovering some of the advantages which the past has shown to be attendant upon simplicity in construction, light-weight pistons, rods and crossheads, and short rigid wheelbases.

Passenger cars were progressively strengthened through the years in response to public insistence for protection against the horrors of early train accidents. This was accomplished by adding greatly to their weight. Vestibules, non-telescoping car ends, and steel construc-

"... the railways possess a valuable asset in being able to offer high-speed transport combined with an exceptional degree of safety and reliability"

"The train-service staff shares responsibility with railway management"

tion throughout were successively adopted, increasing the weight of the 50-ft. 50,000-lb. coach of 1860 to anywhere from 130,000 to 160,000 lb. for the equivalent, conventional 70-ft. coach or chair car of the present day. Limiting values of wheel and axle loading, consistent with the speeds and services of the past, have been determined and passed on to us for our guidance. Six-wheel trucks under passenger cars appeared in 1876, long before car weight reached the level of steel construction. Car riding qualities were improved by the change while wheel loads were reduced to nominal values.

It is no longer necessary to adhere to massive construction to achieve the essential degree of security for passengers. The lightest of the modern cars of standard size weighs from 100,000 to 115,000 lb. Refinements in truck design have shown the way to passenger comfort without resorting to six-wheels and articulated construction,

Advantage has been taken of all these advances in the art of car building with too little regard for the burden imposed on wheels and axles. The car wheel of today is admittedly superior to that of 1900 but resistance to wheel defects has been unable to keep pace with the increased rigors of the service to which it is subjected. Confidence in our ability to meet modern demands with modern materials, has perhaps, resulted in our unjustifiably ignoring the conditions which accounted for relative freedom from the wheel defects and axle and bearing failures in the past. These have multiplied coincidentally with the simultaneous adoption of high wheel loads and greatly increased speeds.

So long as trains were operated under similar conditions throughout the country, it was sufficient to assign a maximum static loading upon a wheel-and-axle assembly of given journal dimension, particularly since this loading value had been determined by experience in observing the loads under which axle failures were or were not recurrent. A static load limit was thus no more than an index of capacity rather than a specification of stress to which the axle would be subjected and, so long as the speed operated did not exceed a common conventional maximum and elasticity of the track was uniform, the dynamic loading bore a relation to the static figure which was substantially constant.

The basic limiting static loads, first selected by the Master Car Builders' Association, were applicable to wheel and axle assemblies installed under freight cars. Since the dynamic effects at higher speed were known to impose more severe duty in passenger service than in freight, despite the improved spring suspension systems employed in the former, the various railways and car owners arbitrarily selected modifying ratios of permissible loading when wheels and axles were installed under passenger-train cars. These ratios varied from 70 to 85 per cent of the freight values. It is significant that those administrations which adopted the lower unit loading have been more successful in meeting the modern tendency toward universally higher speed than those who were less conservative.

Direction of Future Railway Expansion

There is a decline in railway mileage and a further decline will be observed and should be invited on the grounds of economy and appreciating net revenue. The railways of our country embrace approximately one-quarter of a million miles of track of which probably ten to twenty per cent should be abandoned as no longer economically justified. Half the traffic is concentrated on about 22,000 miles of line, or less than ten per cent of the whole. The administrations operating the remainder have to survive as best they can on such profits as may be derived from handling the other half of the traffic.

The average ton miles of freight hauled per capita has increased approximately three and one-half times since the figure of 1,280 ton miles was recorded in 1890. This is due at once to the greater availability of commodities originating at points remote from the regions of consumption, and to the demand for more merchandise per capita, following upon a higher national standard of living and greater value represented by the transport service performed. The railways alone are accountable for the former and they have contributed generously to the latter. As long as there were new territories to be opened and new reservoirs of natural resources to be tapped, enlargement of transport activities was automatically encouraged and its direction was specified. The railway burden was that of providing the facilities which would satisfy the transport demand and, if the service were available, patronage was assured no matter what the type of service might be.

Further growth must follow a demand which the railways themselves create in competition with agencies which operate independently of railway management. More diligent and strenuous effort must be expended in maintaining the economic status and prestige of the industry under these conditions and the success of the expansion program is no longer solely related to the capacities of locomotives, cars and rails but it is the direct responsibility of railway officers and men, to be personally achieved. The train-service staff shares the responsibility with railway management since the formulating of policies would be thoroughly incompetent under existing conditions without the full support of these in whose hands the economical administration of these policies must rest.

In common with many other branches of railway service, the offices of road foremen have been charged with duties which are much more complex and exacting than those common to them in the past. Each mechanical detail of the equipment that they supervise presents

new problems through refinement of detail. Road enginemen and firemen must be highly trained specialists, equipped with that store of knowledge and sincere loyalty which insures proper care of a costly mechanism, the nurturing of an increasingly sympathetic attitude on the part of the railway patron, and consistent economical and precise conformity with difficult schedules. The road foreman must be a man of varied capabilities, free to educate, free to plan, free to supervise, free to analyze. His duties are not confined to the cab and his competence is not measured by the number of unusual but effective schemes of manipulation which he devises, sometimes grossly in error. The modern traveling engineer is truly an administrator of the service who will not permit the enforcement of an unnecessary speed restriction and who will weigh, without prejudice, the value of mechanical changes which are recommended to apply to the locomotives under his supervision.

Brake Shoes and Signals

It is only in the recent past, in fact with the introduction of the Diesel-electric streamlined trains, that it has been necessary to depart from the standard brake shoe dimensions, 3⅜ in. by 13¾ in. which has been nationally used in both freight and passenger service for both 33-in. and 36-in. wheels. The necessity for change has been occasioned by greatly increased braking ratios. Always higher in passenger service (90 per cent in full service, 60 lb. brake-cylinder pressure; or 150 per cent in emergency, 100 lb. brake-cylinder pressure), the new trains have adopted values ranging from 160 to 270 per cent braking ratio corresponding to 100 lb. brake-cylinder pressure. So great has become the concentration of pressure upon brake shoes when installed in accordance with familiar practice that their contact faces rapidly disintegrate and their effectiveness is diminished.

Two schemes have been employed to relieve this undue pressure. First, the brake heads have been so constructed as to accommodate two shoes per head, the shoe length being modified to adjust the braking surface to actual requirements. The other plan requires a single long brake shoe affording increased contact area. Provided the shoe area is the same in either case, it apparently matters little whether the shoe is cast in one or two parts. Insufficient data are available to warrant definite and well founded recommendations. The single long shoe breaks in the approximate center immediately upon the first heavy brake application and is thereafter allowed some measure of freedom in adjusting itself to the wheel tread as the double shoe is permitted to do upon application. Brake-shoe laboratory dynamometer tests show a slight apparent increase in the average coefficient of brake-shoe friction from high speed favoring the long shoe. The interrupted face of the double-shoe design effectively breaks up the spark stream and is subject to less warping. The long shoe is much heavier to handle; the double shoe requires double keying. Both designs serve satisfactorily in service and there is no unified opinion which accepts either to the exclusion of the other.

The special object of the elaborate modern system of main-line signaling and control is to enable each train to run over the line with as high a degree of safety as it would enjoy were it the only train on the track as long as the signals show a clear right of way and except as restrained by them. If signals are not visible, no speed is safe; if clearly visible at all times, any speed is safe in so far as the hazard of collision is concerned, provided the brake equipment and signal spacing are so coordinated that a stop within the distance controlled by a signal is assured. Signals should then be clearly visible and automatically responsive. The brake should be of such capacity that there can be no question with respect to the ability of the engineman to stop within the distance of track which the signal shows to be unoccupied.

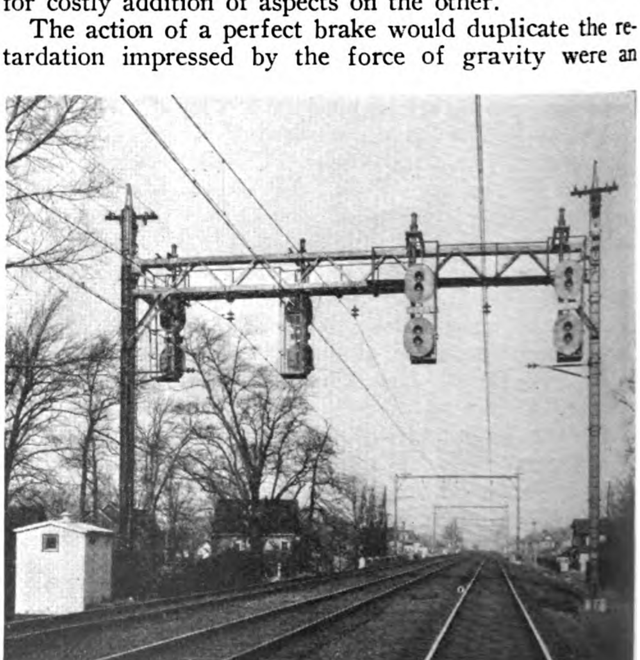
The greater the signal spacing, the greater is the road delay whenever signals display other than clear indications. This delay is greatest and most costly for the slower movements but affects all trains. For scheduled movements, all such delays either interfere with on-time performance or require higher top speeds during the remainder of the run. To avoid costly respacing of signals for high-speed services, with the equally costly delay which follows, brake equipment types of increased capacity are required when the highest current speeds are to be exceeded.

High Speeds Call for New Brakes

A great part of the railway signaling system in this country has been laid out to conform with service stopping distances and 60 m.p.h. speeds. Each brake type is fortified by an emergency feature whereby the 60 m.p.h. service stopping distance need not be exceeded by trains operating at moderately higher speeds. Infrequently used, the emergency capacity is always available to enginemen should conditions require a minimum stop within fixed signal spacing.

New conditions are now presented. Modern main-line passenger trains are no longer moderately in excess of 60 m.p.h. In some territories they have almost doubled this figure and this has called for complex and costly signal arrangements where the conventional brake has been retained. Other administrations have utilized the brake types which offer the greatest capacity and most varied capabilities, adopting the plan which not only permanently equips the high-speed trains for high-speed service in whatever territory they may operate, but conserves the high cost of sacrificing flexibility in the operation of all trains, fast and slow, on the one hand, and forestalls the necessity for spending vast sums for costly addition of aspects on the other.

The action of a perfect brake would duplicate the retardation impressed by the force of gravity were an



"The special object of the elaborate modern system of main-line signaling and control is to enable each train to run over the line with as high a degree of safety as it would enjoy were it the only train on the track

One of six Rocket Diesel-driven trains placed in service on the Chicago, Rock Island & Pacific

ascending incline with suitable gradual approach suddenly presented in front of a train to arrest its motion. An ascending grade affects each pound of train weight in the same manner. To produce this effect, there should be no delay in securing the retarding force when the brake application is initiated. This is accomplished by electric propagation of the brake impulse in the HSC brake schedule, the latest design of passenger-car brake equipment and the one installed in the most modern high-speed train equipment. The rate of brake-cylinder-pressure build up, which corresponds to the gradual approach to our hypothetical slope is adjusted to attain the maximum retardation effect at the fastest rate consistent with comfort of passengers. In emergency applications the ideal comfort consideration is sacrificed for stopping distance and a pronounced retardation effect is felt as the brakes are applied.

There remains to be considered the rise of the slope with which the ideal brake should compare. If the speed were sufficiently high and the grade progressively steeper as the train proceeded to a stop, the full force of gravity, represented by a vertical ascent, could be utilized. Wheel sliding would not be a factor. In the retardation of trains by pressing brake shoes against wheel treads, the limiting rate of retardation is fixed by adhesion at the rails. All of the evidence that has been collected indicates that adhesion values are practically constant as long as wheels rotate without slippage and the coefficient of adhesion approaches or attains its static value. This value is, of course, variable with rail conditions.

Will Balanced Braking Become Effective?

A constant retarding force will produce a constant retardation rate. This is highly desirable in effecting emergency stops of minimum length. A constant brake-shoe pressure will not assure a constant braking force because, under such circumstances, the retarding force would follow each variation in the coefficient of brake-shoe friction and if the retardation rate were to approach the limit of wheel sliding at high and moderate speeds, destructive sliding would occur in the low-speed range. In recognition of the desirability of limiting the retarding force to that which will not cause wheel sliding, the Decelakron was developed and is used in conjunction with the HSC brake to police the retardation rate during heavy brake applications.

Directly and delicately responsive to the rate of retardation, the Decelakron functions to reduce brake-cylinder pressure as the rate of retardation approaches the point of wheel sliding. Although a rate of 3.5 m.p.h. per sec. should be a conservative specification, insofar as the limitation of wheel-rail adhesions are concerned, it has not been found possible to attain this high rate satisfactorily with trains yet constructed for the reason that the relation between retarding force and weight supported has not been reasonably uniform in each of the trucks in the train and braking ratios have not been sufficiently high to impress this rate in conjunction with the low coefficient of brake-shoe friction at high speed. Consequently, were a retardation rate of 3.5 miles per hour per second to be obtained with existing equipment as now braked, it would be required that some wheels and some trucks be braked to retard at a much higher rate with the probability that wheel sliding would occur. This too is a grave defect in the attempt to secure high rates of retardation with the more conventional types of passenger trains hauled by steam locomotives, particularly in cases where new trains, embodying light-weight cars, are involved. Slack action, when permitted to assume any high value, aggravates the condition.

The installation of the HSC brake, embodying the Decelakron, could not assist in such circumstances. It is quite natural that the greater the proportion of total train weight represented by the locomotive, the greater will be its effect in prolonging the stop. When light-weight cars with correspondingly light unit brake-shoe pressure are included in the train consist, the moderate shoe pressure provides the high coefficient of brake-shoe friction which still further unbalances retardation forces with respect to the weight supported. As long as a uniform braking ratio is specified for all passenger-train cars to be employed in connectional services, those cars which present the lightest wheel loads will be actually braked at a higher level and will, therefore, be especially susceptible to wheel sliding. Introduce slack action, which momentarily reduces speed and permits the coefficient of brake-shoe friction, to assume a high value approaching a static condition, or an uneven and rigid track surface, such as that characteristic of a frozen roadbed and the destructive sliding of wheels is certain to result.

The time has come when the specification of a "standard" braking ratio is not enough. Attempt toward bal-

anced braking has been made in the high-speed Diesel-electric trains and without the approach which has been witnessed to date, the high brake performance recorded could never have been realized. No one is prepared to state the upper limit of locomotive and tender braking. It is a safe prediction to prophesy the abandonment of the use of full-flanged brake shoes on all wheels, including drivers, but the level of braking which can be impressed on steel-tired wheels is unknown. An experimental progressive increase is desirable and necessary if this type of motive power is to compete successfully with the low-wheel, Diesel-electric power unit and display the same degree of safety as measured in terms of stopping distance.

New Attitudes Needed

Despite our predictions that the future of transport is revealed to us, that things to come can be foretold with reasonable accuracy, we must, of course, continue to watch with intelligence for the unfolding of our prophecies—still more for the startling and spectacular developments of which we are assured and which must necessarily invigorate our every thought and action. A single record shattered hastens the day when our projected plans are realized and translated into daily procedure. We are truly in doubt with respect to the time of accomplishment

Marked advance in transport speed awaits new attitudes in this vast industry. It is no less true today than in the first of the nineteenth century when steam ushered in its first remarkable change. Faster travel was then the result of chance discovery. Today, many men are actively engaged in serious study of further improvement which will satisfy a demand which was not insistent when Newcomen, Watt, Trevithick and Stephenson aroused the world with their researches in the power of steam and its application to land transport. It is true that further advance hardly can be expected to multiply many times the best performance of the present by any revelation which will, at once, render all which has gone before completely obsolete. The higher the speeds attained, the more difficult further improvement becomes. A great deal is demanded of us and the people of our country will be served.

Without vast mechanical achievements there could be no progress as we know it. Transport would be restricted as in the days of the Caesars. But power alone can never build an industry. The enlargement of our great railway system was, at the time of its greatest activity, fifty years ago, a capital transaction in human affairs; as such it has kept its place in history—as such it will maintain itself while this nation is commercially and socially prosperous. The scene and the actors have owed nothing to dramatic effects for their profound influence upon the nation. The worth and the force rest wholly in the wisdom, the courage, and the faith they displayed.

The cardinal elements which enter into the value of so great an enterprise are few and by no means recondite. The infinite variety of discordant elements of temporary significance are often less clearly discernible. It is often easier to map the path of transport progress over a period of years, paralleling and keeping pace with social advance, than to trace its intermediate deviations. The vision of the farthest goal which we can conceive must be constantly before us if we are not to be misled in the direction of current forces. There are no casual tasks in railway service if the traditions which we have inherited are to be preserved.

Status of Condensing and

Steam-Turbine Locomotives*

By L. P. Michael†

Report of Railway Fuel and Traveling Engineers' Association includes a description of a condensing steam-turbine locomotive with mechanical transmission

There are, as nearly as can be determined from latest reports, four steam turbine-driven locomotives in road service. Three of these locomotives are being operated in Sweden and one in England. They were all built under the Ljungstrom patents and are of the non-condensing type. The general design is practically the same as for the standard reciprocating locomotives in the countries in which they are being used except that the steam cylinders are replaced by a steam turbine having its shaft at right angles to the longitudinal center line of the locomotive.

This turbine shaft is fitted with a pinion which drives, either direct or through an intermediate gear, a main gear on a jack shaft which extends across the front of the locomotive, under the smokebox.

The direct drive, (pinion to main gear) drives the locomotive in one direction, and the drive from the pinion through the intermediate gear to the main gear drives the locomotive in the opposite direction.

Discs are located on the ends of the jack shaft and are spaced laterally the same distance apart as the driving wheels on the locomotive. Crank pins are located on the outside faces of these discs and carry the front ends of the main rods which extend backward to the main crank pins on the driving wheels in the usual manner.

The general construction of the Swedish locomotives is shown in the *Railway Age* issue of April 17, 1937, page 682, (photograph only) and that for the English locomotive in the February, 1936, *Railway Mechanical Engineer*, pages 53 and 60.

The service obtained from these four locomotives has

* Presented at the Convention of the Railway Fuel and Traveling Engineers' Association, held in Chicago, Wednesday, September 29, 1937.
† Chief Mechanical Engineer, Chicago & North Western.

been reported as being quite satisfactory, and we understand that in Sweden at least, it is expected that more of them, of practically the same design, will be built in the near future.

Turbine Locomotives Designed for Service in This Country

About the middle of last year, a 5000-hp. two-unit steam turbo-electric-condensing locomotive was ordered by the Union Pacific from the General Electric Company, as covered in the 1936 report of this committee.

We had hoped that this locomotive would be completed and in service so it could be covered in this year's report. Work on its construction, however, has been considerably delayed, but it has been reported that it will be completed and ready for test and regular service in the near future.

We understand that this locomotive is to be built in two units, each 90 ft. 10 in. over pulling faces of coupler knuckles and to weigh about 530,000 lb., or a total of 1,060,000 lb. for the complete locomotive ready for service. Each unit is to be of the 4-6-6-4 type and to be of 2500 hp. capacity, making a total of 5000 hp. for the locomotive.

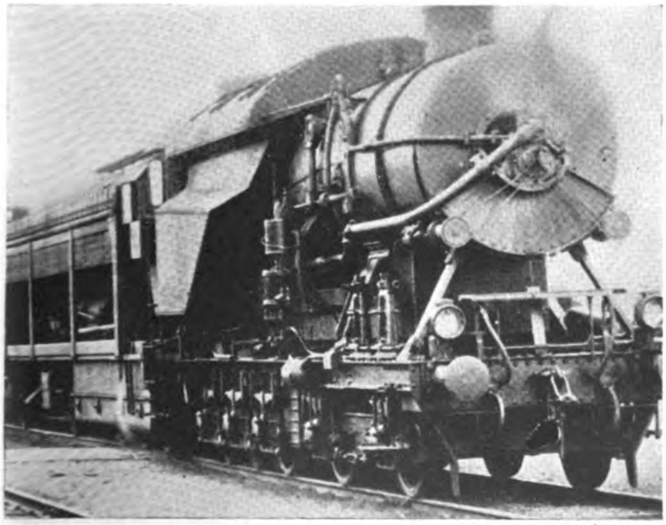
Each unit is to have a high-pressure boiler to furnish high temperature steam to a compound steam turbine which will be geared to an electric generator which will in turn furnish electric current to the six motors on the six pairs of driving wheels. The boilers are to be entirely automatic and burn bunker "C" fuel oil.

Air-cooled steam condensers are to be used to condense all the exhaust steam from the main turbine and also from small turbines used to drive the auxiliaries. We understand that each unit will have a starting tractive power of 80,000 lb., making a total of 160,000 lb. for the locomotive.

The two units are to be arranged so they can be operated as one locomotive or as separate units. The maximum operating speed will be 110 miles per hour. A complete description of this locomotive and all its details will probably be given in the technical press as soon as it goes into actual service.

Experience Obtained from Actual Service

The most outstanding favorable feature of the service obtained from the steam turbine-driven locomotive is its steady, smooth and vibrationless operation. This results in reduced damage to the locomotive itself and to the roadbed, and consequently reduces the cost of maintaining not only the locomotive but also the track, bridges and entire roadway. This is because there are no reciprocating parts in the driving gear of the turbine-driven locomotive and, therefore, no dynamic augment generated by counterbalance weights as is produced in the reciprocating engine-driven locomotive.



Early Ljungstrom turbine locomotive built in Sweden for service in Germany

One very definite unfavorable fact in the details of the operation of steam turbine-driven locomotives has been brought out in the service obtained from them in both Sweden and England. This fact is that during starting and low speed operation, the steam consumption is very high and, therefore, the efficiency of the locomotive is very low, and if there is frequent starting and a considerable percentage of the time consumed in low-speed operation, the high steam consumption during this period more than offsets the benefits derived from the low steam rates obtained when the locomotive is being operated at higher speeds.

One manufacturer of steam turbines for locomotives in Europe has resorted to a modified form of turbine blade in an effort to flatten the steam-rate curve and obtain lower steam rates during both low-speed and high-speed operation, and thus in a measure overcome the unfavorable conditions referred to above. This style blade, however, increases the steam rate for intermediate speeds and in effect, "robs Peter to pay Paul," which is probably not the best method to improve the over-all steam rate and efficiency of the turbine and drive for locomotive service.

The steam turbine-driven and also the reciprocating engine-driven locomotive horsepower curves start at zero and increase to a predetermined point at intermediate speed and then drop off rapidly toward maximum speed and are roughly of parabolic form with the axis vertical.

The inherent characteristics of the steam turbine and the relation between the driving wheel diameter and piston speed produce this contour of horsepower curve for the steam turbine-driven and the reciprocating locomotives, respectively. If a three-speed gear were available, similar to what is used in automobile construction, it would be very desirable not only for steam turbine but also for reciprocating steam engine driven locomotives.

This construction would flatten the horsepower curve and make greater horsepowers available at both low and high speeds and provide greater starting tractive power, all of which is very desirable. To date, three-speed gears, or even two-speed gears, have not been considered practical to transmit large horsepowers for these two types of locomotives. Electrical manufacturers have been confronted with similar problems in the construction of electrical equipment for rail service.

It has been necessary for them to provide a compromise or considerably modified construction in an effort to produce equipment to deliver high starting tractive power and a reasonably flat horsepower curve for low intermediate and high-operating speeds. This compromise or modified construction for electric drive equipment, namely, generators, controllers and particularly the motors has resulted in a considerable loss in efficiency and a lowering of the horsepower output curve.

Research Work Done by the Committee

As a means of obtaining greater fuel economy and lighter and better operating power units, this committee has for a number of years, been endeavoring to develop and recommend to this association, a steam turbine-driven condensing locomotive with a transmission

of higher efficiency and, therefore, delivering greater horsepower at the drawbar for the weight and cost of the power unit than can be obtained from either the present direct mechanical, or the electrical transmissions.

The electric transmission, as far as operating characteristics are concerned, is very desirable, and is more flexible than the direct-drive transmission.

[The report, which was signed by Chairman L. P. Michael, chief mechanical engineer, Chicago & North Western, included at this point a detailed description of a condensing steam-turbine locomotive with mechanical transmission, the principal features of which may be summarized as follows.—Editor.]

The locomotive is to be moderately streamlined, 84 ft. long over couplers, to weigh 500,000 lb. ready for service, have 64,000 lb. starting tractive power, develop 4,000 hp. on slightly less than nine pounds of steam per hp. per hour and condense all of this steam including that from auxiliary turbines and use it again as boiler feedwater. The boiler is to deliver steam at 1200 lb. pressure and 850 deg. F. temperature to the steam turbine.

The boiler is to be of the uniflow, single-coiled-tube type, with preheater, evaporator, steam separator drum and superheater for steam generation and with a cylindrically shaped burner through which vaporized distillate fuel oil and preheated air is blown and burned on the outside of the burner in a short blue flame similar to that from a gas plate or Bunsen burner.

The gases of combustion are to pass radially outward from the burner through the evaporator coils, superheater and preheater section of the coiler tube and then through a combustion air heater before passing out the stack. An efficiency of 85 per cent is obtained with this type of boiler which is of a very small and compact design and comparatively light weight.

The steam turbine to be of the impulse-reaction type designed for a speed of 8000 r.p.m. at 120 m.p.h. The bladed portion of the turbine to consist of two 24-in. mean-diameter Curtis wheels in series followed by 18 stages of reaction blading.

The steam condenser is to be of the cast-aluminum fin-section or, copper-fin-tube type located and forming the entire roof portion of locomotive cab the full length of the locomotive frame. Eight 9-ft. diameter fans are to be used to draw air through ducts at the ends and sides of the cab and blow it upward through the condenser. The condensation to be drained to a hot well from which a triplex pump is to return it to the boiler.

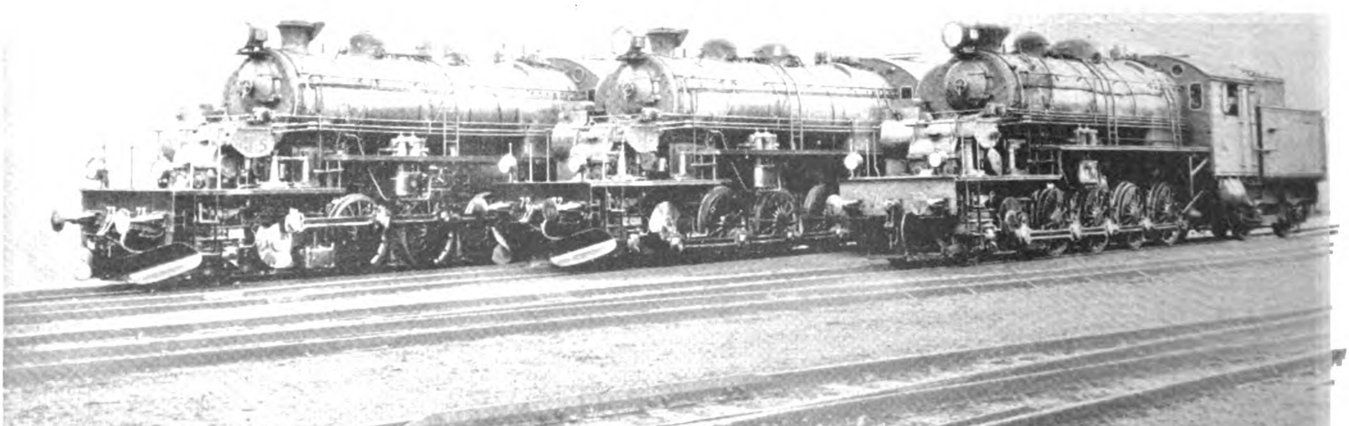
The transmission of power from the steam turbine is to be through a reducing gear from about 6700 r.p.m. to 1800 r.p.m. at 100 m.p.h. to a driving shaft and through a hydraulic coupling, epicyclic traction increasing gear at low speeds (the latter to be inoperative at higher speeds), then through a reversing gear to shaft driving hypoid pinion and gear on each driving axle.

The locomotive is designed to be operated at 110 m.p.h. at equal speed and tractive power in either direction. The efficiency of the direct driving gearing from steam turbine to the rail at the driving wheels is expected to be over 90 per cent, or about 15 per cent higher than for the electric transmission used with Diesel powered or steam-turbine powered locomotives.

The higher efficiency of direct mechanical driving gearing, combined with small sized but efficient boiler, turbine and condenser, permit this locomotive to be built in one unit, whereas, a steam-turbine powered locomotive with electric transmission must be built in two units and a Diesel-powered locomotive in three units to transmit the same power at the draw bar. This would indicate that the turbine-powered locomotive with direct mechanical transmission can be built at less than half the weight and at slightly more than half the cost of the locomotives with electrical transmission.

The cost of maintaining these locomotives is expected to be in direct proportion to the number of units or the weight of each type of locomotive.

One important factor of the operation of these three types of locomotives, was brought out by the writer of this report. This was that the quantity of fuel oil used by each type of locomotive will be such that with the higher efficiency and lighter weight of the steam-turbine-powered locomotive with direct mechanical transmission using furnace distillate fuel at 5 cents per gal. and the steam turbine-powered locomotive with electrical transmission using Bunker "C" fuel at 3½ cents per gal. and the Diesel engine locomotive with electric transmission using Diesel distillate at 5½ cents per gal., the cost per horsepower hour at the draw bar, would be practically the same for the three types of locomotives, even though the Diesel (engine only) had the higher efficiency and the turbo-electric used the cheaper Bunker "C" fuel oil.



Ljungstrom non-condensing turbine locomotives in Sweden—Locomotive No. 71 was placed in service in 1932; Nos. 72 and 73, in 1936

EDITORIALS

A Good Source of Information

Committees appointed by the mechanical associations sometimes have great difficulty in securing information which they need in making their studies and reports. Moreover, frequently a committee will present a report which is far from what it should be, considering the fact that more complete and authentic information than is included in the report is readily available, if one knows where to look for it.

Officers of the various mechanical associations and members of the technical committees should not overlook the fact that the Association of American Railroads has established a Division of Engineering Research, under the direction of L. W. Wallace, who makes his headquarters at the Chicago office of the association. This division has made plans for and is aggressively prosecuting research into a number of important technical problems. Beyond this, however, it is establishing its work on the basis of a service agency, with a technical staff to supply information to any of the groups which may call upon it. Here, then, is an invaluable agency which can be of great assistance to committees which may be appointed during the coming weeks to prepare reports for next year's conventions.

Building a Convention Program

The mechanical associations, most of which resumed their activities this year, suffered heavy losses in membership during the depression and naturally may be expected to have considerable difficulty in rebuilding and toning up their organizations for the most effective functioning. It must be admitted that, considering the fact that they had such a short time in which to prepare their programs, they made unusually good showings at this year's meetings. On the other hand, if they are to meet reasonably well the demands that will be made upon them, they must put a lot of hard work into their future programs, giving more attention to a proper coverage of their respective fields and going more thoroughly into details. This will naturally require a high type of committee service.

It is significant that both the Railway Fuel and Traveling Engineers' Association and the Master Boiler Makers' Association kept their committee organization pretty well intact during the depression years, and were successful in featuring excellent committee reports on this year's programs. The other associations filled in the gap by calling upon experts for addresses on vital problems in which their members were interested, and through the provision of open forum discussions. These devices are excellent, but they cannot, of course, fill the place of carefully prepared committee reports. All of the associations are faced with the problem of appointing well-balanced committees to study and report on the more important problems in their respective fields. This is no simple task and it must be done immediately to insure strong and well rounded-out programs for next year. It would seem well, also, after the committees are appointed, to give them more or less detailed instructions as to what is expected of them and exactly how to proceed. Many of those who will be invited to function on the committees may have had little if any experience in such work, and they cannot be expected to perform efficiently without some guidance.

A good chairman is indispensable, but there has frequently been much misunderstanding as to the qualities of a good chairman. A good chairman is not a man who will do all the work himself. Obviously a report prepared under such conditions will be limited in perspective and findings. A good chairman is one who can get the members of his committee to co-operate in gathering information and in assisting to digest it. While the chairman may have to do a large part of the work in finally whipping the report into shape, he must have real co-operation from all of his associates. Beyond this, however, every member of an association should feel a responsibility for furnishing such information as he can to the various committees.

The task of the executive committee of each of the associations is to see that the committee assignments are made at once; that the committees are followed up from time to time to insure that the work is being carried forward aggressively; that additional committees are appointed to meet any emergencies that may arise during the year; and that the reports are available early enough so that copies may be made and furnished to the members well in advance of the annual convention. Only in this way can the most thorough and constructive discussions be held.

In many instances the members of a committee will be so widely scattered that it may be difficult, if not impossible, to hold meetings, and a large part of the work will have to be done by correspondence. Railroad mechanical department supervisors and foremen, like other busy men, are, generally speaking, poor cor-

respondents, and unless they make an unusual effort, will delay and dally along until the report will finally have to be whipped into shape under almost impossible conditions, and can hardly be expected to reflect great credit upon the organization. This handicap presents a very definite challenge for intelligent and earnest effort and co-operation.

The *Railway Mechanical Engineer* believes in the practical value and great importance of the mechanical associations. If they function successfully it will not only be to the great advantage of the railroads, from a dollars and cents and efficiency viewpoint, but it will very greatly enhance the positions of the men who are responsible for making such records. On the other hand, if the members and officers of the associations are not willing to make a reasonable sacrifice and make a real effort, the railroads and the members will fail to profit and the associations will have to be discontinued because of lack of vitality. Several of them faced up to their possibilities in splendid shape this year. Have they the ability to keep up the pace over the long run, or have they simply qualified as sprinters?

Co-operation Between Mechanical Associations

In reorganizing the mechanical associations and scheduling their meetings over a four-day period, with a common exhibit, certain inconsistencies developed at the recent meeting at Chicago, the elimination of which will require careful consideration on a co-operative basis between the various organizations. It has always been the practice, for instance, for the General Foremen's Association to schedule reports and addresses on both locomotive and car repair shop and maintenance problems. Obviously there was a certain sound basis for this, since many of the general foremen have jurisdiction over both classes of work.

On the other hand, the Car Department Officers' Association, which has restricted its activities to the car department, has also in the past given much attention to car repair shop and maintenance questions, both associations thus duplicating their work in part. The inconsistency of this was clearly apparent at the Chicago meeting, when the two associations met in nearby rooms, on the same floor of the hotel, at the same time. An executive officer of a railroad which had representatives attending both meetings was rather perplexed, and indicated that some of his men were not sure just which meeting they should attend at certain times.

Quite obviously the problem could be solved by restricting the activities of the General Foremen's Association to locomotive shop and enginehouse problems, but staggering the meetings of the General Foremen's and Car Department Officers' Associations so that the general foreman interested in both locomotive and car matters could attend that part of the car officers' meeting in which he was primarily interested; or possibly some way could be found of considering such matters at joint sessions.

Matters relating to management problems, training of workers and public relations are of common interest to members of more than one of the associations, and here again, the question of scheduling joint sessions is worthy of consideration. A study of the programs of the four associations which met in Chicago indicates the presence of several outstanding speakers on such topics, who were listened to by only one of the groups, although a joint session of several of them might have profited greatly from these addresses. The larger audiences would also have afforded greater justification for the time and attention which these officers gave to the preparation of their addresses and attendance at the conventions. These matters might well be given serious and careful consideration by the officers of the different associations in planning next year's programs.

Wheel Shop Practice Needs Checking

Doubtless no car-wheel shop in the country is so well equipped, organized and supervised that no further improvements can be made in the methods employed for turning out car wheels for freight and passenger service. It is equally true that a certain number of shops—perhaps more than is generally realized—on the other end of the scale, are following wheel-shop practices which can be accurately described only by the word used in referring to bad eggs when they are bad enough.

Wheel shops in which unsatisfactory repair practices are followed include those operated, in some instances, by car builders and private car owners as well as railroads, and usually it is the small poorly equipped shop which is the principal offender. In an effort to improve still further the performance of chilled-iron car wheels, the Association of Manufacturers or Chilled Iron Car Wheels has recently sponsored a study of actual wheel shop practice, which indicates that, in many instances, reduced wheel life and possibly even failures, charged to design or manufacture, are really due to malpractice in assembling the wheels and axles in the wheel shop.

A specific study of conditions in six shops taken at random in one important railroad center showed that at all of these shops wheels were bored off center in varying amounts from 3/32 in. to 3/8 in. Wheels were bored as much as 1/8 in. out of true with the flange. One five-jaw boring mill was discovered with the boring bar .015 in. loose in the housing and only four of the five jaws holding the wheel. As the result, wheels were bored 1/4 in. off center and with two tapers of .005 in. each, small in the middle of the hub, and .004 in. out-of-round.

Similarly, axles were found turned in worn-out ma-

chines with bent spindles and bad centers, resulting in inaccuracies of as much as .023 in. taper and .004 in. out-of-round in journals and wheel seats. Wheel presses also were inadequate to do a satisfactory job of wheel mounting, in one case there being 10 tons difference in reading between the indicating and the recording gage, and, in another, a machine equipped with a 14-in. ram had a recording gage designed for use with a 9-in. ram machine.

Not all of the difficulty can be charged to inadequate machinery, however, as in some instances the wheel bores are measured with calipers, thus rendering totally ineffective the accurate measurement of axle diameters with micrometers. Press tolerances are sometimes estimated by holding calipers up to a light; wheels are gaged at only one place in mounting; wheel sticks are used on journals in turning wheels. Additional information regarding the results of this inspection of a number of car wheel shops will be shown more in detail in an article in a subsequent issue of *Railway Mechanical Engineer*.

The indictment of current wheel-shop practice, presented by this study, is, of course, not general, for many car-wheel shops, operated by car builders, private-car owners and railroads, are turning out excellent work. The importance of wheel-shop work, as effecting the safety and economy of railway operation, is such, however, that in even the best of shops, a comprehensive check of detail shop practices may well be undertaken to make sure that no pair of wheels, deficient in any particular, is permitted to leave the shop. Obviously car-wheel shops which are less well-equipped and supervised, should in varying degree, be improved to meet the requirements of this exacting phase of equipment maintenance work.

The primary responsibility is upon managements to furnish adequate wheel-shop machinery and equipment and see to it that practices, recommended in the Wheel and Axle Manual of the A.A.R., Mechanical Division, are religiously followed. It is also the duty of wheel-shop superintendents and foremen to impress upon their superior officers, both in season and out of season, the urgent necessity of installing modern equipment and adopting the modern methods without which satisfactory wheel-shop operation is impossible.

New Books

CAR BUILDERS' CYCLOPEDIA OF AMERICAN PRACTICE. *Compiled and edited for the Association of American Railroads, Mechanical Division. Published by the Simmons-Boardman Publishing Corporation, 30 Church street, New York. 1,308 pages, 8½ in. by 12 in. Price: Cloth bound, $5; leather bound, $7.*

The fourteenth edition of the Car Builders' Cyclopedia follows the same general arrangement as previous editions. The material is so arranged and indexed that reference to the general index or the list of contents gives the location of each class of cars or appliances, while the complete detailed index embodied in the definition section gives a reference to each specific car or part. Other indexes—Directory of Products, Trade Name Index, and Alphabetical Index—are given in the last pages of the book. In the fourteenth edition, however, the division into sections has been more clearly defined and the arrangement somewhat changed in order to make the material more readily accessible. The list of contents by sections and sub-divisions and the alphabetical index to car parts have been improved and a summary of the contents of each section has been added on the first page of the several sections. The Cyclopedia gives definitions and typical illustrations of cars, their parts and equipment; descriptions and illustrations of shops and tools employed in their construction and repair, and cars built in America for industrial operations and for foreign railroads. New designs of cars and appliances in the field of railway car construction have been included as far as possible so that this edition might contain the latest practices in American car construction and equipment.

HOW TO MAKE ALIGNMENT CHARTS. *By Merrill G. Van Voorhis, M.Sc. Published by the McGraw-Hill Book Company, Inc., New York. 114 pages, 6 in. by 9 in. Price, $2.50.*

The purpose of this volume is to provide the most direct instructions on how to make nomographic or alignment charts for the solution of engineering and other formulas. Major stress is placed on how to handle the various types of equations. Theory of construction, which is not essential to the understanding of the procedure in making the charts, is not interspersed with the material but is briefly outlined in the Appendix for reference. Graphical construction methods are described wherever practical, along with a mathematical method. Examples are given with every type equation to demonstrate the detailed procedure for making the charts according to the directions provided.

DIESEL PLAN BOOK AND ENGINE CATALOG. *Volume Two. By John W. Anderson. Published by Diesel Engines, Inc., New York. 320 pages, 13½ in. by 11 in. Price $2.00.*

The 1937 edition of this catalogue is an addition and supplement to the 1936 edition. It contains a record of further accumulations of engine and plant designs, of studies of plant installation problems, and of experience gained in Diesel engine application. The catalogue section includes descriptions, diagrams and illustrations of many sizes and types of engines. The plan book section describes different Diesel plants and gives reports of studies of individual application and installations plus discussions on various special problems. This Diesel engine catalog is of particular interest to railroad Diesel maintenance and operating men because of the detail information which it contains on the various types of engines and their accessories.

Gleanings *from the* Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

Torn Between Two Loves

Played a dirty trick on the railroads by driving a new car home from Flint, Mich., but still am a rail fan, as I did not ride any stages on my round trip in crossing the continent.

More Efficient Car Repair Practices

You have been hitting the ball, but would appreciate a little more for the car department—something in the line of standardizing car repair work and the use of standard and efficient tools. Some railroads use different practices at each car repair point, although uniform practices would save time and money. Care should be taken so that the best methods are adopted.

Walt Wyre a Help and Inspiration

I desire to take this opportunity to express my appreciation of the articles in the *Railway Mechanical Engineer* by Walt Wyre. There is much of interest in his articles, which, if taken advantage of by railroad officials and others, would certainly help to lift the load from many roundhouse foremen and other supervising officials on the railroads, since we all know that the impossible is sometimes expected of such officials.

Mechanical Conventions at Chicago

I really enjoyed meeting a number of mechanical men and looking over the exhibit. I was impressed with the fact that there were a lot of serious minded men present. I do think that if another such group of meetings is held at one time, there could well be some joint meetings, as some of the subjects discussed by one association were very pertinent to the delegates to another meeting held in an adjoining room, and vice versa.—*Executive Officer.*

How Can We Compete With Them?

No one can accuse the Interstate Commerce Commission of being very tender-hearted when it comes to dealing with railway owners and managements. I wonder if you were as amazed as I was at the report of I.C.C. Examiner R. W. Snow, in which he recommended for common and contract carrier motor carriers as maxima a 60-hour week, or not more than 70 hours in any period of eight consecutive days, with limits of 15 hours "on duty" and 12 hours "at work" in any period of 24 consecutive hours. How can the railroads compete with such common carriers? Remember, also, that the motor transport carriers operate over public highways, while the railroads must not only supply their right-of-way, but must pay heavy taxes upon it.

When He Stopped to Think!

When your representative was here last month I told him I did not care to renew my subscription to the *Railway Mechanical Engineer*. In the last few days, however, I have been reviewing back copies and must frankly admit that I did not realize until now the benefits I had obtained from them. I decided I had better send you my check, which is enclosed herewith, as I do not wish to miss any numbers.

Where Will They Find the Space?

First, in discussing the mechanical conventions at the Hotel Sherman in Chicago last week, he stated that it was the most successful and profitable meeting he had ever attended or exhibited at, not excluding the Atlantic City conventions. He lamented the fact that they had taken such small space at the convention and thanked me very much for urging him to be there. He said that next year they will have an exhibit that will probably steal the show.

Checking and Repairing Men

At least one statement made by Vice-President Woodruff in his address before the International Railway General Foremen's Association, and reported on page 435 of your October number, should have been played up in prominent, black face type. "Years ago," said Mr. Woodruff, "many men were fired—thrown on the scrap pile just like broken castings. Now we weld the castings and it is part of the foreman's job to use the same principle with his men. The old practice of hiring and firing is obsolete. * * * A human being needs checking just the same as a locomotive boiler, following up with the necessary repairs." Here is a unique and yet most rational conception of the job of a foreman or supervisor, and yet I wonder how many of us recognize it as a vital, or possibly the most vital element in our work. I know it gave me quite a jolt when I read it.

Waste Grabs and Hot Boxes

The studies to be conducted in the Chicago terminal district under the sponsorship of the Bureau of Explosives and the Freight Claim Division of the Association of American Railroads, on the effect of rough handling of freight cars to reduce damage to equipment and lading, is timely. No allusion has been made to the study of waste grabs from packing in journal boxes, which might well be included in the studies, since the majority of hot boxes are caused by waste grabs formed in terminals. The majority of hot boxes occur from 25 to 50 miles from principal terminals. If the sub-committee to be appointed, including "representatives of other departments to analyze the handling of cars," will include journal box packers, oilers and inspectors familiar with journal box performance, additional data on the effects of rough handling in disturbing journal packing, jumping of bearings off journals at speeds from five miles per hour, upward, will be illuminating, especially to operating supervisors, who are still unconvinced that journal box performance is affected by rough handling. This opportunity offered in the proposed terminal studies will provide an excellent set-up for procuring definite data on potential hot box conditions.

THE READER'S PAGE

More Hot Boxes In the Summer?

TO THE EDITOR:

Relative to the lubrication of car journals, the railroads have realized the advantage to be gained by using a satisfactory grade of waste and oil. Not long ago it was the practice to use two grades of oil, commonly referred to as summer and winter oil, but this was found to be impractical and as a result it was quite generally agreed that a suitable grade of oil should be used for all-year service. Unquestionably an oil that will perform satisfactorily under all climatic conditions would be ideal. It is fully realized by the writer that the lubricant alone, no matter how good the quality, will not produce satisfactory results unless accompanied by close inspection to see that the journal-box packing is properly applied and all mechanical parts are in proper order.

The writer is fully cognizant of these requirements and although they are rigidly adhered to on his road it is his experience that more hot boxes occur during the summer, especially when it is extremely hot, than during other periods of the year. While not an alarming situation, it raises the question: Why should there be more hot boxes in the summer than in the winter?

It would be interesting to learn of the experience of others and what have been their findings and remedies.

TRAVELING CAR INSPECTOR.

Drill Tang Breakage

TO THE EDITOR:

In your June issue of *Railway Mechanical Engineer* I read with interest an article concerning drill tang breakage. It seems to me that the statements made are true enough, but that they do not go far enough.

Depending upon the size of drill, there is a clearance of at least 0.010 in. between the thickness of the tang of the drill and the width of the keyway in the socket. If the drill shank and the socket are not in 100 per cent contact due to the presence of some foreign matter, or damaged taper, and the holding power at the taper becomes insufficient, there will be a movement between the drill taper and the socket taper of about 0.010 in. until the tang takes hold. The load is suddenly applied to the tang which often twists off. Had this load been applied statically rather than by impact, it would have been of much smaller magnitude with much less destructive results.

I have found a means of remedying this situation which has worked out excellently for me. First, clean the drill and socket tapers. Second, see that the tapers are not damaged. Then, put the drill in the socket, but before "driving the tapers home," twist the drill counterclockwise, or in the opposite direction of its rotation until the corners of the tang are touching the sides of the keyway. Then "drive the tapers home."

In this way there can be no relative movement in the socket, with the resulting impact loading of the tang as both the tang and tapers are holding the drill from the very start. This method is very effective and so simply applied that your drill tang breakage should show a drop as soon as it is instituted.

LEONARD A. KROLL.

Thermal Checks in Hubs of Engine-Truck Wheels

TO THE EDITOR:

The letter from "General Foreman," in the September issue of the *Railway Mechanical Engineer*, requesting information on thermal checks in the hubs of engine-truck wheels, focuses attention on a locomotive defect about which little mention has been made heretofore. Is this because the condition is not general, but rather is one being experienced by only a few roads? It certainly appears to be a serious problem on the road employing the author of the previously mentioned letter.

Thermal checks usually are the result of high concentration of compressive forces on rapidly rotating surfaces, the generation of heat from friction between the surface being a factor which accentuates the condition. Therefore, it is altogether possible that the thermal checks, as described by "General Foreman" may be the result of combined factors. If the road is one with sharp curves, the lateral pressure between the faces of the engine-truck boxes and the wheel hubs might be excessive and approach the point where checking might start, this being especially true if high speeds are maintained on curves. Again, if many reverse curves are encountered, and high speeds are maintained causing alternate impacts on opposite wheel hubs, the reversal of stresses might be a contributing factor to thermal checking. Undoubtedly the mechanical condition of the engine truck itself, including spring rigging, can also be a contributing factor if not maintained properly.

In discussing any problem involving rubbing surfaces, one should have a knowledge of the metals used. "General Foreman" neglected to state whether the box faces or liners are of steel, brass or another alloy. Assuming that the hub face is steel and the road and operating conditions are as mentioned in the preceding paragraph, that is, sharp curves and high-speed trains, then high lateral forces on single curves, heavy impact forces of reverse curves and excessive friction between the faces of the wheels and the hubs will undoubtedly present the most favorable conditions for promoting thermal checks on the wheel hubs. Are these the conditions which actually exist on "General Foreman's" road? It seems probable because thermal checking of engine-truck wheel hubs occurs very rarely when precautions are taken to hold friction between the box face and the wheel hub to a minimum by employing an alloy box liner or box face.

There are many types of alloys and designs of liners, both floating and anchored, from which "General Foreman" might select one that would serve as aid in solving his problem. Perhaps the writer is presumptuous in assuming that such remedies have not been tried. It would be interesting to learn what steps "General Foreman" has taken to solve his problem.

MASTER MECHANIC.

IN THE BACK SHOP AND ENGINEHOUSE

Device for Forming S-Hooks

The fabrication of S-hooks of ¼-in., ⅜-in. or ½-in. stock for supporting cab curtains, air hose, signal hose and steam-heat hose can be accomplished with remarkable ease by using the device illustrated in this article. The device, as shown in Figs. 1 and 2, consists of linkages *A, B, E, F, G* and *H* and a handle *J* fitted with two conduit nipples around which the hook is bent. Fig. 1 illustrates the device with a straight section of round stock in position ready for bending; a completed S-hook is shown removed from around the nipples and set on the edge of the device for illustrating its shape.

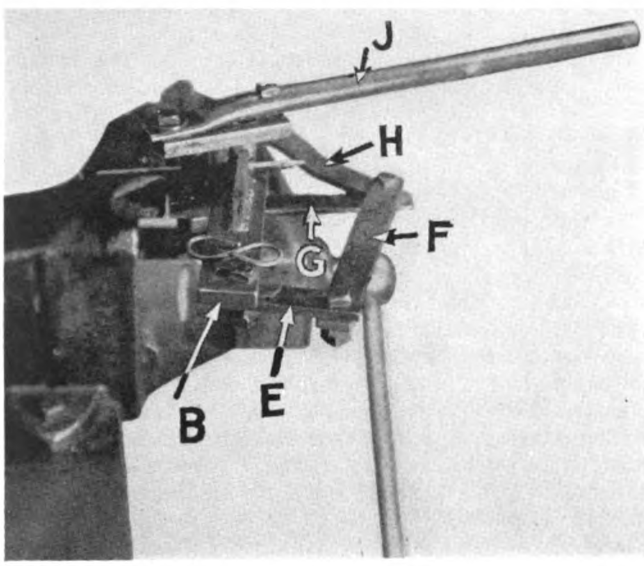


Fig. 1—The S-hook forming device with round stock in position for bending. A completed hook removed from the nipples is illustrated

The parts of the device are lettered similarly in Figs. 1, 2 and 3. Fig. 2 shows the starting, halfway and end position of the handle *J* and the various links during the forming of a hook, while Fig. 3 shows the details of the major parts. The accompanying table lists the various parts necessary to make the device.

List of Materials for the S-Hook Bending Device

Part	No. required	Description*
A	1	⅝ in. by 2 in. by 9 in. flat iron
B	1	⅝ in. by 2 in. by 9½ in. flat iron
C	1	½ in. by 2 in. by 4 in. flat iron
D	1	⅜ in. by 1¼ in. by 4 in. flat iron
E	1	⅜ in. by 1¼ in. by 5¾ in. flat iron
F	1	⅜ in. by 1¼ in. by 10½ in. flat iron
G	1	⅜ in. by 1¼ in. by 9¾ in. flat iron
H	1	⅜ in. by 1¼ in. by 12 in. flat iron offset near the middle to line up with other parts
I	1	⅝ in. by 2 in. by 5 in. flat iron
J	1	¾ in. diameter by 23 in. long conduit
	1	¾ in. by 2 in. pipe nipple, standard thread on one end only
	1	¾ in. by 2¾ in. pipe nipple, standard thread on one end only
	1	¾ in. by 2½ in. stud threaded ⅝ in. from one end only
	1	¾ in. by 4 in. stud threaded 1¾ in. from one end only
	6	½ in. by 2 in. bolts
	6	½ in. nuts
	1	¾ in. nut

* All parts to be drilled or drilled and tapped as shown in Fig. 3.

Parts *C* and *D* are notched as shown in Fig. 3. The long edge of part *C* is welded to the top of part *A,* and the long edge of part *D* is welded to the top of part *B,* each being set back about ¾-in. from the center of the ¾-in. studs in parts *A* and *B*. One of the ¾-in. studs, which is 4 in. long, is screwed into part *A* while the other ¾-in. stud, 2½-in. long, is screwed into part *B,* both in the location shown in Fig. 3. However, the ¾-in. by 4-in. stud screwed into *A* extends through both *A* and *G* where it is locked in place with a ¾-in. nut. The handle is made up of the two parts *I* and *J,* and two ¾-in. conduit nipples, the longer of which is located as shown in Fig. 3; parts *I* and *J* are fastened together with ½-in. bolts. The remaining ½-in. bolts listed in the table are used to fasten the links *A, B, E, F, G,* and *H,* as shown in Fig. 2, at the points where they join. Parts *A, G,* and *G* remain stationary during the fabrication of the hooks, while all the other parts are free to move.

In applying the handle *J,* the two nipples slip over the studs in parts *A* and *B*. When the handle is in position there are spaces between the nipples and the lower, middle and top notches in parts *C* and *D* of ¼ in., ⅜ in. and ½-in., respectively. These spaces permit the insertion of ¼-in., ⅜-in. or ½ in. stock in the respective notches, depending on the size of the S hook desired. The round stock to be used for the hook should be cut in lengths of approximately 8½ in.; the proper position of the stock before starting the bend can be ascertained

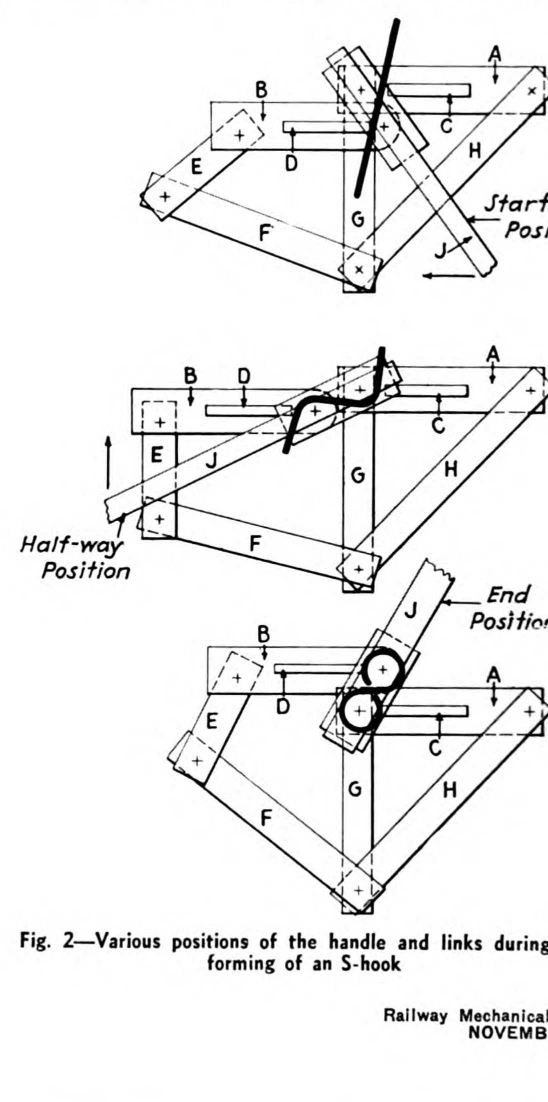


Fig. 2—Various positions of the handle and links during the forming of an S-hook

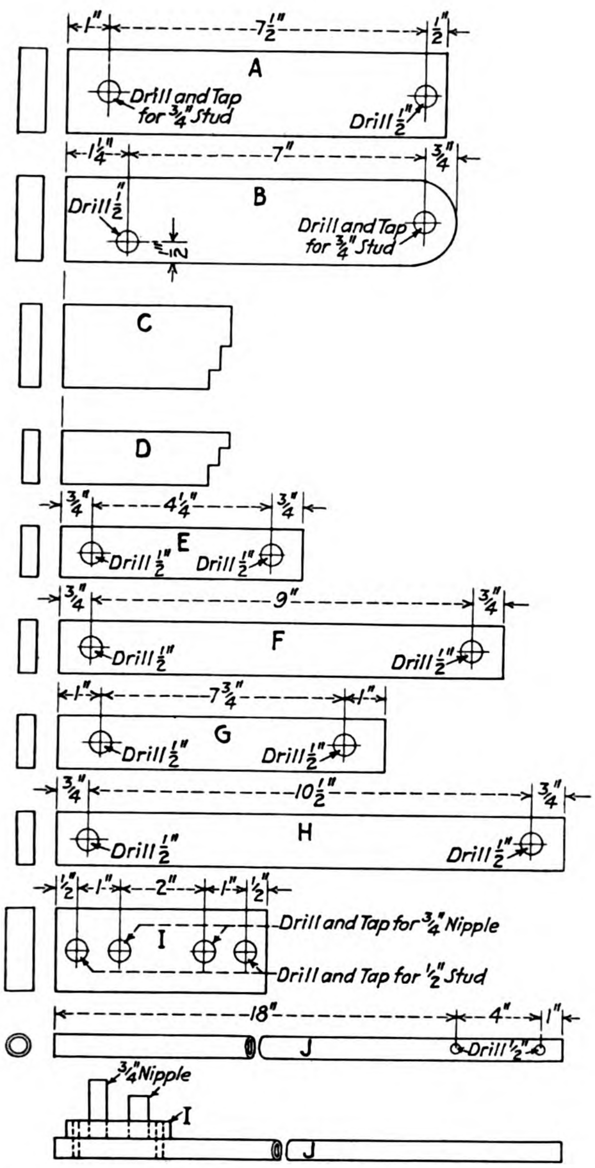


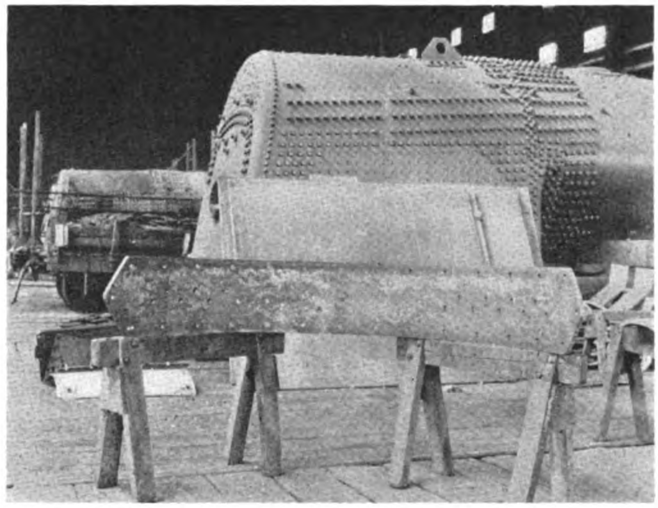
Fig. 3—Details of device for bending S-hooks—See table for a description of the parts

by trial. After the stock is in position, the handle *J* is rotated in a clockwise direction as shown in Fig. 2. The stock, held securely by parts *C* and *D*, is forced to follow around the nipples as the handle *J* is rotated, thus forming the hook. The device is capable of turning out several hooks per minute, regardless of the size stock being used.

Waist Sheet Liner Application

When a crack occurs in a boiler course at the waist and guide-yoke sheet, because of the heavy load carried by this sheet, supplemented by severe vibration stresses, it is standard practice on the Northern Pacific, among other roads, to apply a waist sheet liner between the boiler and the waist sheet angle, as shown in the illustration. The liner, made of 3/4-in. steel, is sheared to the correct shape, rolled and fitted hot to the boiler shell. Rivet holes are punched, as shown in the drawing, and the appearance of the liner just before application to the boiler is indicated in the other illustration.

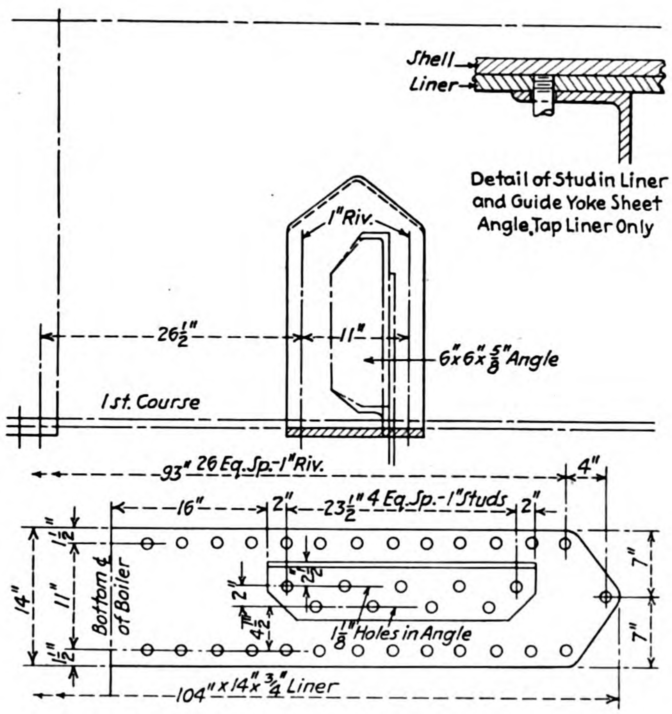
The liner is riveted to the boiler shell in the proper location and caulked to make all joints steam tight. The waist-sheet angle, one on each side, is applied using nine



Waist-sheet liner fitted to the boiler and ready for application

1-in. studs which extend through the liner but not into the boiler shell, as shown in the cross-section detail.

The application of this waist-sheet liner greatly strengthens the boiler construction at a point of severe



Details of waist-sheet and guide-yoke-sheet liner application

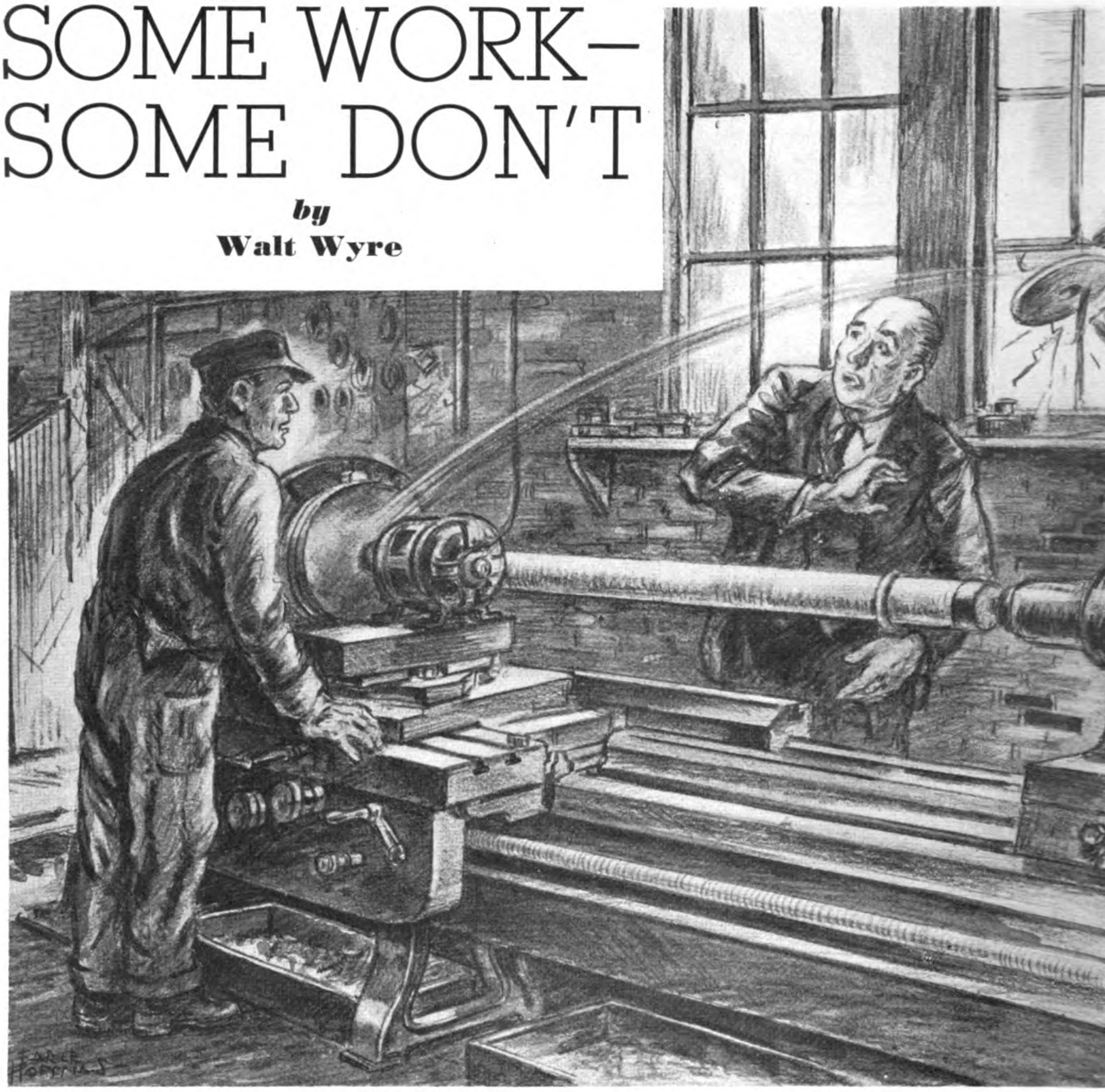
stress and, in the unlikely event that the liner should become cracked, it could be readily replaced and repairs effected without disturbing the main boiler course.

Brittle Rails.—Glass rails were proposed for railway service by Friedrich Siemens of Dresden, Germany, back in 1886. He reported that he had succeeded in casting glass in the form of rails which would be no more expensive than iron and would have the advantage of being transparent; hence any flaws could be detected before laying the track. Tests were actually made in the glass factory to see if the glass rails would be suitable for railroad service.

SOME WORK—SOME DON'T

by

Walt Wyre



Wham! The wheel zipped past Starkey's head and crashed through a window

If the superintendent of motive power had not bragged about the machine for grinding valve gear links and blocks there would not have been so much scrap loaded from the S. P. & W. roundhouse at Plainville, and the company would have saved considerable money. Nobody knows how much the machine cost, there are no records to show, and it's well enough there aren't for the peace of mind of all concerned.

John L. Starkey, general roundhouse foreman, is the daddy of the link grinder and is proud of it and well he might be. It's a good machine and does a nice job. The grinding wheel operates on an adjustable arm that can be set to the exact radius of links and blocks so that when finished they fit perfectly together.

A reverse screw on the principle of a lathe feed reverses the travel automatically at the end of each cut and once set, the machine operates automatically. Takes a little time to set the machine but not a great deal more than required to set up some of the factory-built ones and this one was built right in the shop at Plainville. Starkey not only will, but does, tell any and all that will listen about the link grinder and demonstrate how it works. "Didn't cost hardly anything," Starkey explains. "Just built in spare time."

Jim Evans, the roundhouse foreman, could add that overtime on engines mounted considerably higher during the two months the grinder was being built, but he doesn't. That's not where most of the money spent nor the scrap iron shipped came from. If, when the grinder was finished, it had stopped there, all would have been well, but inventive genius, once inspired, dies hard. When the S.M.P. told Starkey what a good job he had

done, the general foreman set out to modernize the shop at Plainville with home-made tools. Being something of an admitted specialist in grinding, he continued his efforts along that line.

Machinist Cox was calipering the right main pin on the 5070 to make a bushing when Jim Evans came up.

"How is it?" the foreman asked.

"About as round as an egg," the machinist replied. "No wonder the bushings have to be renewed every trip."

Evans bit off a piece of "horseshoe." "Yeah, going to have to hold her and renew the main pins pretty soon. Would do it now if I had another engine. Wish we had a pin grinder—sure save a lot of time and money," the foreman added.

"That's right, and I've been figuring on one," Starkey came up and joined in.

"Think there's any chance of getting a new pin grinder?" Evans asked doubtfully.

"Not buying one—build it," the general foreman replied. "One shouldn't be any harder than that link grinder I built; not as hard, in fact," Starkey added.

"Well, we sure need it," Evans commented.

"Well, I'm going to build one—good one, too." The general foreman headed for the machine shop, his eyes aglow with inventive inspiration.

"Say, Mr. Evans, I've got to get a stud burned out of the 5081 right away. She's called for 4:30." Machinist Jenkins seemed a little peeved.

"Well, why don't you get a torch and burn it out?" the foreman told him.

"That's just the trouble! Boilermakers are using one torch and Martin is using the other cutting out a frame for some kind of machine. Starkey is with him and told me to get the other torch," the nut-splitter explained.

Evans shifted his cud of "horseshoe" from one jaw to the other. "I'll see what can be done about it."

Barton, a boilermaker, was using the cutting torch in the fire-box of the 5072 fitting a patch on a siphon to be welded. That job was just as important as burning the stud out.

"How long will you be using the torch?" Evans asked Martin who was making molten metal fly from a piece of heavy angle iron.

"Oh, I don't know," the machinist said hesitatingly.

"Ain't there but one torch?" Starkey cut in.

Evans hesitated a moment then turned and went back to the roundhouse. "Work noon hour on the 5081. Maybe you can get a cutting torch then." And the first extra hour of labor chargeable indirectly to the S.M.P.'s bragging about the link pin grinder was added to the payroll.

STARKEY has the pin grinder pictured in his mind but the machinist wasn't a mind reader and the general foreman couldn't explain clearly enough for the nut-splitter to understand exactly how the machine was to be built. The mental picture Starkey carried was of the finished machine with no detail of individual parts and made clear understanding of construction difficult. The work progressed slowly with a great deal of cut, try, and make fit.

Starkey spent most of his time with machinist Martin working on the pin grinder, leaving Evans to look after work in the roundhouse alone. Evans didn't mind that so much, but losing his best machine hand for the time was a considerable handicap. On top of that, a big portion of the time Martin was using the best lathe in the machine shop while work needed for locomotive repairs was being held up.

"How's the pin grinder coming along?" Evans asked Starkey one day.

"Pretty good. I'm afraid, though, we're going to have to build a new frame for it. The angle iron we used seems a little light. Seems too springy."

"Think it's going to work all right when it's finished?"

"Oh, sure," Starkey replied. "Come out here and I'll explain how it's going to work."

"Might explain to the master mechanic why overtime is running so high while you're explaining," Evans said, trying to appear to be joking.

At last the pin grinder was finished all except a motor to run it. There was no motor available.

Starkey scratched his head trying to figure out where he could get a motor.

"What size and speed motor do you need?" Ned Sparks, the electrician, asked.

"Well, about a five-horse-power, I'd say, and it ought to run about 1,500 revolutions a minute," Starkey told him.

"It'll either have to be 1,800 or 1,200 r.p.m.," Sparks said, "and I don't know where you can get either one, unless you use the motor on the old drill press. It's not used much," the electrician added.

"We can do that to test the grinder with, and if we need the drill press we can put the motor back on it," the general foreman agreed.

Starkey picked a day when the master mechanic was out of town to try the grinder. Rods were taken off the left side of the 5088 and the machine trundled up to the left main driver.

Every man in the roundhouse not engaged in work of pressing importance was in a place to see without being seen. Locomotive cabs on either side served as grandstands for the occasion. Whispered remarks, witty and otherwise, were rife.

"Looks like a cross between a model-T strip-down and a baby cement mixer," one man commented.

"Wonder where the cobs come out?" another asked.

"When does the threshing start?" a boilermaker inquired elbowing through the crowded cab.

"Right now, if you don't stay off my feet," a machinist informed him.

Starkey, unaware of his knot hole audience, with machinist Martin helping, adjusted the grinder in position.

At last the machine was ready to go. Starkey closed the switch. The motor started. The emery wheel began to revolve while the spindle went round and round the pin like a comet with its fiery trail of sparks.

"That ought to get the job done," Starkey exulted.

"Little rough, isn't it?" Evans stooped to inspect the part of the pin that had been ground.

"Stop it a minute; let's take a look," Starkey said.

"Yes—it is a little rough," the general foreman admitted reluctantly. "Looks like the wheel is bouncing."

"It won't run like that." Evans reached for his plug of horseshoe and started down through the roundhouse.

The pin was rough and "little" didn't describe the condition. Corrugated suited the appearance of the ground surface better than rough. It was as wavy as a woman's head still wet with hair setting solution.

"Maybe a light finishing cut will smooth it up," Starkey said hopefully.

Finishing cuts—not one, but two—helped some, but not enough. And when calipered, the pin showed a decided taper caused by wear of the grinding wheel and spring of the arbor. An attempt to compensate by adjusting the cut as the wheel progressed resulted in rings around the pin.

"He'll get the pin ground if he don't run out of metal

before it's finished," a passing machinist observed, speaking carefully low so the foreman wouldn't hear.

All day Martin worked with the machine personally supervised by the general foreman. Just before five o'clock, the grinder was disconnected and wheeled into the machine shop. Starkey had tired lines on each side of his mouth but he wasn't ready to admit defeat.

Next day a machinist and helper put in eight hours with files and emery cloth smoothing the main pin enough to run without burning up.

Several changes were made in the pin grinder. Some helped, others didn't, but he never got it perfected to the point that it could be called good. The master mechanic finally put a stop to further experimentation on it. The motor was placed back on the drill press. Other working parts were scrapped and the frame was converted into a stand for air pumps.

THE inventive spirit within Starkey received a considerable jolt, but it was only dormant, not dead, and finally revived entirely. Remembering that he had built a link grinder that worked, Starkey was still a specialist in the grinder line.

A tool post grinder was to be his next masterpiece.

Machinist Martin, erstwhile and ex-builder of personally supervised pin grinders was polishing a piston rod in a lathe. Emery cloth was the polishing medium held against the piston rod with a strip of leather belt fastened to the tool post of the lathe. The emery cloth did a nice job of polishing and left the surface of the rod slick as a spanked baby's place where they spank them, but required more time than Starkey thought it should. Hence the tool post grinder.

Finding a motor was the first consideration and, as it happened, easily solved. There was a one-horse 3,600 r.p.m. motor in the electric shop that had formerly been used on a blower fan.

"Just the thing," Starkey told the electrician. "Fix up an extension cord to plug in a welder outlet."

Building a bracket to mount the motor on the tool post and making a mandrel for an emery wheel on the motor shaft wasn't much of a job. Next day the tool post grinder was ready for a trial.

A piston with rod was mounted in the lathe and the home-made grinder secured to the tool post. The general foreman noticed it first. "We'll have to get a bigger wheel," he said.

"Why?" Martin asked.

"The frame of the motor is so large it won't let the six-inch wheel touch the rod," Starkey replied.

"That's right," the nut-splitter agreed. "Want me to get a 12-inch wheel?"

The 12-inch wheel fairly hummed when the motor was turned on. Martin ran the tool post in. The abrasive bit; sparks flew; then, wham! The wheel zipped past Starkey's head and crashed through a window.

"What happened?" Starkey asked anxiously.

"The motor—it's running in the wrong direction," Martin said. "Looks like one of us would have noticed it."

That was soon corrected and the grinding wheel retrieved. The general foreman, still slightly nervous from his recent narrow escape, started the lathe and gently eased the tool post forward and the grinding started. Somehow results were not as expected. Although not as rough as the work of the pin grinder, the finish on the piston rod was far from smooth. In fact, the serrated surface of the rod was rougher than the lathe tool had left it.

Starkey scratched his head. Different grades of grinding wheels helped little or none. The general foreman was about ready to quit when centrifugal force took matters out of his hands. Once more luck was with them. No one was hit by the flying fragments that whistled through the air like pieces from a bursting shell, but that finished the tool post grinder. More time was charged to the link grinder and more material went to the scrap bin.

THE lesson of the tool post grinder was not severe and didn't last long, but it convinced Starkey that he was not an expert on grinding.

The next and most pretentious machine effected the cure; the master mechanic said it did.

Starting with an out of date and little used crank planer, the general foreman decided to build a milling machine. It wasn't to be just a dinky little affair for cutting key-ways and such, but a real honest-to-goodness machine that would finish a cross-head gib with one cut like he had seen pictured in advertisements.

When the general foreman had finished rebuilding the crank planer into a milling machine, the original builder wouldn't have recognized it. The bed operated with rack and pinion instead of from a crank. Milling cutters replaced tool posts. The cutters were driven from an electric motor through an intricate gear arrangement. Twice the weight of the finished machine went into the scrap bin during the three months in which the shop was working on this machine.

Like the previous instances, overtime in the roundhouse increased, knocking the M. of E. allowance as full of holes as Swiss cheese. The master mechanic came in unexpectedly at the time the new milling machine was to be tested. Theoretically, the idea of the machine was good, but lack of proper facilities for building, incorrect calculations at seemingly unimportant points and use of parts that should do instead of ones built to exact specifications sent the idea on a detour.

The table ran too fast, cutters too slow, gears clashed and rattled. The master mechanic came in just as a cutter gouged and jerked the cross-head gib from the bed of the machine and hurled it to the floor.

"What in the devil have you got here?" the master mechanic asked.

"Why—er—it's a milling machine," Starkey stammered.

"Who built it—Rube Goldberg?"

"We built it, in spare time—" Starkey flushed brick red. "It needs a little adjusting and it ought to work all right."

"Well, the next spare time you have, try adjusting it to a place in the scrap bin where the superintendent of motive power won't see it."

"But—" Starkey didn't get a chance to finish.

"I know what you're going to say—we need a milling machine and with a little more time you can make this work. Maybe so, more likely not. There are some tools that can be profitably built in a roundhouse but not many. Machine tool designing is highly complicated."

"The link grinder—"

"Yes," the master mechanic interrupted again. "The link grinder does a very good job and is mighty good, for a home-built machine. It's needed, too, just like we need a lot of other tools, but in the long run most home-built machines cost more than ones bought outright and stand in the way of approval for new ones.

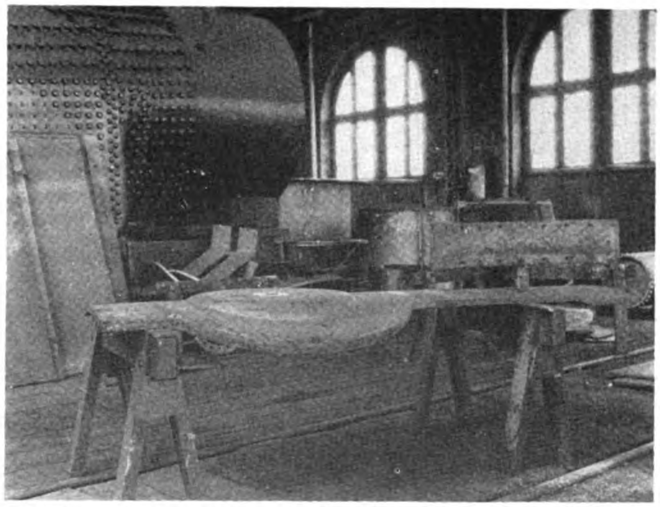
"Maybe some of these days the company will buy some of the tools we need. In the meantime, if the management can put up with the ones we've got, we'll have to too."

After Starkey cooled off he saw that the master mechanic was right.

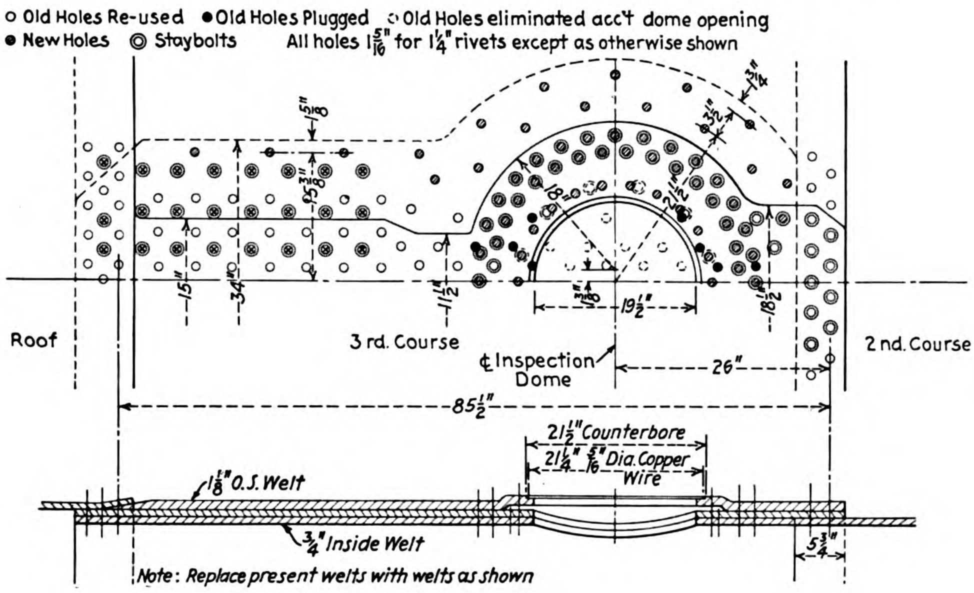
Inspection Man-Hole Liner Applied

To give access to locomotive boilers for annual inspection purposes without going down through the main steam dome which requires removing the throttle standpipe, it is common practice on some roads to apply a man-hole liner to the longitudinal seam of the third course as shown in the illustrations accompanying this article. Two views showing this liner both before and after application to the boiler are presented in the half-tone views and details of the construction and application, as used at the Brainerd, Minn., shops of the Northern Pacific are given in the drawing.

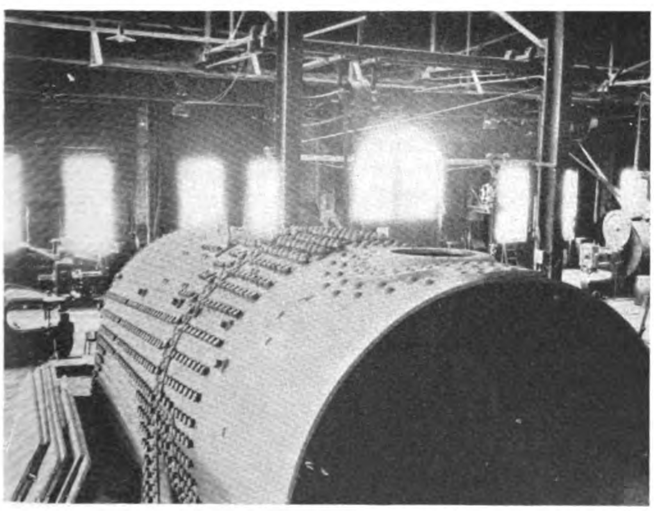
The liner is made of 1⅛-in. boiler steel, formed hot in male and female dies of appropriate design under a 3500-lb. steam drop hammer. The liner is trimmed to size with an oxy-acetylene cutting torch, the seat faced and counter bored for a steam-tight joint with the cover



Inspection man-hole liner flanged and ready for application



Details of application of boiler inspection man-hole liner



Back end of boiler showing inspection man-hole liner applied

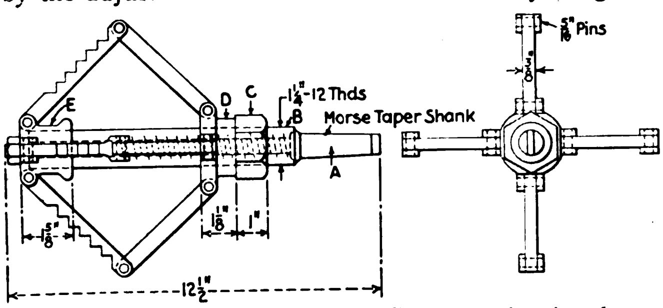
and necessary rivet and stud holes, either punched or drilled as required.

On the boiler, the inside and outside butt straps are removed and replaced by this new liner which incorporates the man-hole. Rivets are applied and seams caulked in the usual manner. Studs are applied around the man-hole opening and a pressed dome cap, made of 1⅜-in. steel, faced, drilled and bolted in place over the liner studs, the joint being made steam-tight by a 5/16-in. copper wire gasket, in accordance with the usual practice.

Adjustable Mandrel For Steam Pipe Rings

The adjustable mandrel shown in the illustration was designed by a western road for grinding steam pipe and superheater header rings from 4 in. to 9 in. in diameter. It is adjustable by means of the nut *C* on the 1¼ in. pipe or tube *B* which threaded for about two-thirds of its length. The Morse taper shank *A* has a spindle portion ½ in. in diameter which extends through the tube *B* and terminates in a threaded portion on which a ½ in. nut is screwed. This spindle portion is centered at the threaded end by passing through a hole in fixed spider *E* which is screwed on the end of the tubing. When this nut is tightened the ball shoulder at the large end of the Morse taper shank centers the spindle in the tubing at the shank end, thus securely holding the as-

sembly which then revolves as a unit. The adjustable spider *D* slips freely over the threaded tubing and by tightening nut *C* the steam pipe ring is securely gripped by the adjustable notched members. The adjusting nut



This mandrel can be adjusted for grinding steam pipe rings from 4 in. to 9 in. in diameter

and spiders may be made of brass and the rest of iron or steel. This mandrel which weighs 10 lb. is an improvement over the customary tapered wooden blocks used to grind in steam-pipe joints.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Working Nickel Steel

Q.—Our railroad recently purchased some locomotives which use nickel steel in the boiler construction. I have read numerous articles but have not come across anything that gave me any information as to the proper method of working this particular steel.

I would like some information in regard to heating this metal, as in applying a patch, etc. The general opinion seems to be, to keep heat away from this metal as when fitting up a patch and getting it ready for riveting. R. M.

A.—There is no objection to heating nickel steel, provided it is done properly. It is advisable in heating nickel steel, preparatory to working, that the temperature range from 500 degrees to 700 degrees F. be avoided. Uniform application of heat until the plate is cherry red should produce satisfactory results in forming the patch. When cooler or in the 500-degree to 700-degree F. range, the steel is "blue brittle" and difficulty through damaged plates may be encountered if it is worked in this range.

When local heating is necessary, it should be done over the largest area possible and the use of drift pins should be reduced to a minimum. In all laying up, a large area flatter should be used so that no markings whatever are made in the sheet, or, to be more exact, the sheet surface should not be fiber stressed or cut in sections by the marking of a hammer. In rolling high tensile alloy steel, more time is required, due to the toughness of the metal and the application of pressure on the rolls should be placed on minimum sections at more frequent intervals. Where nickel steels are used, the service demands are exacting and are such that exceptional strength and ductility are required. For this reason, patching is to be regarded as a doubtful practice unless it is done by competent men under proper supervision.

The bulletin on "Nickel Alloy Steels in Railroad Locomotives" discusses the effect of heating and cold working on nickel steel. This bulletin can be obtained from the International Nickel Company, Inc., New York.

Locomotive Fuel Rates

Q.—For what rate of firing are modern boilers designed?—K. F. G.

A.—For all practical calculations the fuel rate of a saturated-steam locomotive can be taken as 4 lb. of coal for i. hp. hr., and for superheated steam locomotive it can be taken as 3.25 i. hp. hr. When developing maximum tractive force, the indicated horsepower for a saturated steam locomotive can be computed as

$$hp._{sat.} = 0.0212\ PA$$

while for superheated steam locomotives the horsepower can be computed as

$$hp._{sup.} = 0.0229\ PA$$

where, in the two foregoing equations, *P* is the boiler pressure in lb. per sq. in., and *A* is the cross-sectional area of one cylinder in sq. in. As an example, take a Pacific-type 4-6-2 locomotive with a boiler pressure of 200 lb. per sq. in., 23-in. by 28-in. cylinders and equipped with superheater units. When developing its maximum tractive force this engine, based on the foregoing equation for superheated steam locomotives, will develop $(0.0229 \times 200 \times 415.5)$ 1,904 i. hp. hr. Based on the fuel rate of 3.25 lb. of coal per i. hp. hr., this engine will burn $(1{,}904 \times 3.25)$ 6,188 lb. of coal per hr.

It should be understood that with higher boiler pressures and steam temperatures as well as improvements in the design of locomotive and appurtenances, the fuel rates will be lower than those previously given, running in some instances to as low as 2.25 lb. per i. hp. hr.

Factor of Safety For Locomotive Boilers

Q.—Would you kindly explain how to arrive at the factor of safety? For locomotive boilers, it is four. What I want to know is how is that figure obtained?—N. K.

A.—The term, factor of safety, is defined as the ratio of the ultimate strength of the material or structure to the allowable stress. In boiler work, the term factor of safety, can be taken as the ratio of the bursting pressure to the working pressure, thus:

$$\text{Factor of safety} = \frac{\text{Bursting pressure}}{\text{Working pressure}}$$

All locomotive boilers operating in the United States must have a factor of safety of four to comply with the locomotive inspection law. This law states:

Rule 2—The lowest factor of safety for locomotive boilers, which were in service or under construction prior to January 1, 1912, shall be 3.25.

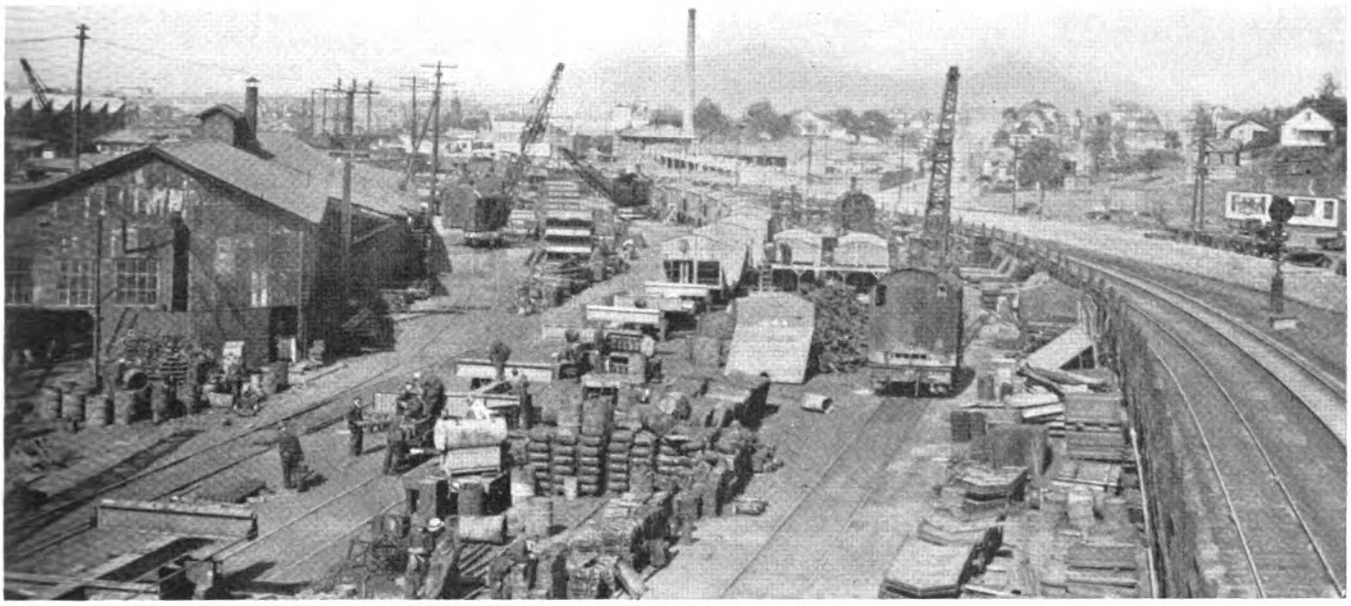
Effective October 1, 1919, the lowest factor shall be 3.5.

Effective January 1, 1921, the lowest factor shall be 3.75.

Effective January 1, 1923, the lowest factor shall be 4.

The factor of safety of four is an arbitrary margin of safety set by law to protect against: (1) Deterioration due to corrosion, (2) Errors in workmanship, (3) The interdependence of parts, (4) The probability of overload, (5) Stresses due to method of suspension, (6) Lack of homogenity in the material.

With the
Car Foremen and Inspectors



A general view of the repair yard layout. Fabricating plant at the left; material storage in the foreground and at the right, and the assembly line at the center of the picture

Modern Methods in Freight Car Work*

By J. E. Echols†

These remarks cover the construction of and the rebuilding or heavy repairs to open-top steel cars but would also apply to other classes of cars.

Building New Cars

On the Norfolk & Western, after the type of car has been selected to suit the needs of service, the leading car supervisors are called in by the mechanical engineers and the plans discussed. Drawings are then started in the drawing room and the car supervisors are consulted almost daily while the plans are being prepared. This method has been found beneficial and gives the engineers a chance to make use of the practical knowledge of the car supervisors by taking advantage of the economical way in preparing the details.

In building new cars and in making classified repairs to cars, the progressive system is used. This system is not new. It has been used by many of the contract car builders throughout the country for years, but the real test comes when an old repair shop layout is converted into a progressive system for new car building and results in a successful, economical output without large expenditures for additional facilities.

The Roanoke, Va., car shop of the Norfolk & Western has the minimum in facilities that can be used in securing an output of 10 to 12 new open-top steel cars per working day. It consists of one large capacity multiple punch; one large capacity shear and one large capacity brake with several small machines for single punching, small shearing and bending, and numerous shop-made machines and tools located within and around a shed. The facilities are otherwise outside and in the open.

The shop yard tracks were not originally laid out for progressive new car building, however, it has been accomplished with no change in the layout of the tracks.

The tracks are not equipped with overhead cranes, therefore, five locomotive cranes are used for the operations, with two small tractors and trailers handling the small materials.

The progressive system begins with the unloading of the material and winds up with the light weighing of the cars.

Unfinished material is unloaded along the track leading to the fabricating machines and much time and trouble is saved by storing the different items so that they can be picked out and moved to the machines without unnecessary handling. The heavy material moves west on the north side of the shed. The assembly begins at the west end and moves east on the south side of the shed.

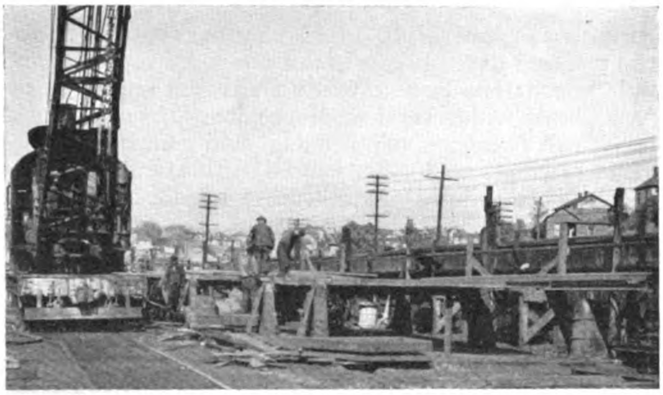
The different operations are grouped in continuous succession from beginning to end, each class of operation being performed at designated places on the construction line, known as stations. These stations are arranged in sequence from Nos. 1 to 11, where the workmen are regularly stationed. The cars, as they progress, are moved to the workmen instead of the workmen going to the cars. The men that have the light operations are used at

* A paper presented at the meeting of the International Railway General Foremen's Association, Chicago, September 28, 29, 1937.

† Car Foreman, Norfolk & Western.

Fabricating the cross bearers in jigs

At station No. 4 on the assembly line



Adjacent to station No. 5 the sides are assembled on jigs

The ends and slope are assembled as a unit and lifted over to the assembly line

times to reinforce men with heavy work in order to keep the line moving on schedule time. In placing the men at the different operations, it is important that the right man be selected for a certain job. This feature requires a good deal of study on the part of the supervisors in order to keep the operations well balanced. To further facilitate the steady movement, the prepared material required at each station is stored adjacent thereto.

Specially-built elevated conveying trucks are used to convey the car frames along the construction line for the body assembling. These trucks are so built as to provide a sufficient amount of space between the cars to avoid cramped working conditions, and riveting can be done without interference from these trucks. The cars are pulled through the construction stations, each car being fastened to the preceding car, with the car in the last station attached to an electric winch, which operates a cable for pulling the cars.

Construction Operations

Station No. 1—Construction is started with the center sills, which move from the machines, upside down, to a rail table. This enables the first operations to begin from the bottom side of the sills without turning them over. These operations consist of burning out key slots, pipe slots, fitting and riveting combination back stop castings, combination striker castings and draft lugs, applying center brake pipe and pipe clamp brackets.

Draft gears, yokes and yoke fillers, draft keys and retainers are assembled and applied in units.

Brake cylinders and brake regulators are riveted on as the last operation.

The assembled sills are then turned over by crane to an upright position.

Station No. 2—Two elevated conveying trucks are spotted and the center plates and the body bolster plates are placed on these trucks. The crane then places the assembled center sills on these trucks. The first operation after the sills are placed on the trucks is fitting on the body bolsters and side bearings. The cross bearer bottom cover plates and the cross bearer diaphragms, also the channel floor supports are then fitted. The connection angles for floor supports are also applied. Jig gages are used, extending from body bolster to body bolster, which are attached to cross bearers to gage the sides and hold the car square as it is built up. The final operation at this station is inspecting and reaming all the fittings made up to this operation.

Station No. 3—After the cars are spotted at this station, the riveting is done in the fittings that have been previously set up at Station No. 2. The air brakes and such other small fittings that can be applied without interfering with the application of the sides, floors and ends are also put on and riveted. The car is then moved to Station No. 4.

Station No. 4—At this station the floors or slope sheets are put in position with such fittings as can be fitted without interfering with the sides and the riveting continued.

Station No. 5—Located adjacent to this station are the jigs and tables for assembling and completing the sides. The assembled sides are put in place by the cranes, the ends are completed and also the lower section of the slope sheets.

Station No. 6—At this station all parts that could not be previously attached on account of interfering with the sides are applied and the riveting continued.

Stations Nos. 7, 8, 9—These stations might be termed finishing stations for the reaming and riveting, and the installation of the remaining air brake parts. The cars are completed at these stations except for the doors and

the electric welding. The cars are then put on trucks, as the truck assembly track is located parallel to these stations.

Station No. 10—At this station the track is elevated on trestle work, which is about 3 feet high and approximately 40 feet long. This is used for the fitting of the drop doors on hopper cars, as it has been found that a better fit can be made by assembling them on the cars. On rebuilt and heavy repair cars, all truck work except wheels, bolsters and truck sides, is done at this station. The elevation of the track makes the underside of the car easily accessible to the workmen. The coupler height is also adjusted at this station.

Station No. 11—This is an electric welding station, at which the construction work is completed. It has been determined by experiments that welding of some of the sheet connections on steel cars is more economical and just as effective as securing with rivets. On gondola cars, the floor is made by using two sheets per car, welded together. The two sheets are also welded to the center sills, through holes punched in these sheets. On hopper cars the center transverse sheet and floor sheets are welded to the side sheets; and to successfully weld them, it is necessary to hold the joints tight; and to accomplish this, a pneumatic clamp was devised to hold all four sections at one time. The box packing and the testing of air brakes is done at this station.

Painting and Weighing

After the welding is completed, the cars are moved to an open track, where all scale is removed from the structure and made ready for painting. The cars are then moved to the painting tracks, which are located some distance from the construction tracks. Painting is done with spraying machines and does not interfere with the construction forces. The painting consists of one coat of red lead and two coats of black paint. The red lead is allowed to stand 48 hours in order to make sure it is thoroughly dry, while the black paint is allowed to stand 24 hours between coats, this depending on the weather to some extent.

After the last coat of black paint has been applied and is dry, the stencilling is applied with a small spray, which is preferable to a brush.

During the construction of the cars, red lead is very freely used at all connections or lap joints. This is beneficial in protecting the steel from corrosion. Where welding is done on the inside of the car, the seams are red leaded and then given a coat of car cement.

The finished cars are then light weighed on the scales adjacent to the painting track and released for service.

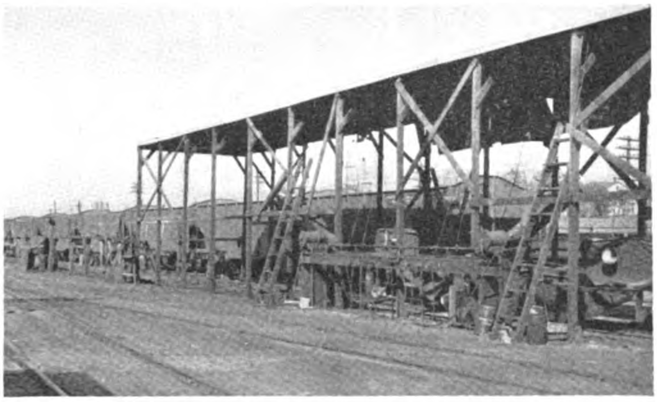
Rebuilding or Heavy Repairs — Steel Cars

In doing this class of work, the cars after they reach the repair line follow very much the same procedure in the course of repairs as that outlined previously for the construction of new cars. However, there is much of importance to be done on this job before the cars reach the shop.

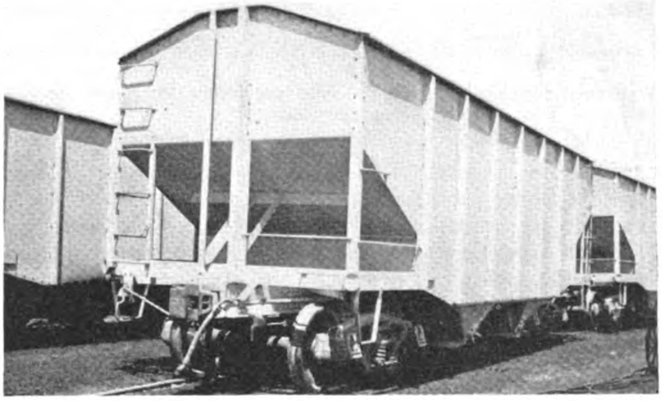
First, after it is determined in advance of the operation the series of cars and how many are to be taken care of, the next move is for the drawing office to get out the original plans and make such alterations as are necessary, after conference with the car supervisors. It is highly important that this be done in order to get the best out of the money to be expended. Certain parts of the cars should never be restored to their original design if failures have occurred to any extent. They should be changed, strengthened and renewed to prevent the possibility of a second failure.

After it is determined that certain items will be re-

After placing the body on trucks, assembled adjacent to the line, the cars move to an elevated track where hopper doors are put up



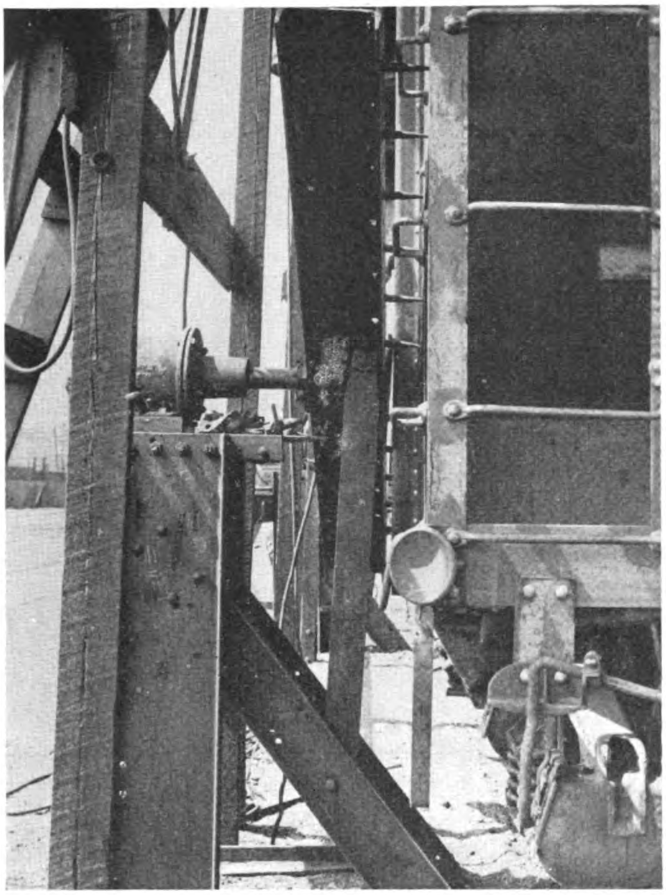
General view of the welding station with line of completed cars before painting



A completed car after a coat of red lead

Weighing the cars before turning them over for service

newed completely on each car, an estimate is then made to determine the percentage of the items of miscellaneous parts required. This gives the stores department a reasonably close estimate as to the exact amount of material needed. The orders are then passed to the stores department for ordering the material. When the material is



A pneumatic clamp holds the car sides and forms the ground for the welding sets

received the fabrication is started by preparing the 100 per cent items for blocks of two to three hundred cars, this is to be determined by the output.

Up to this time, which usually consumes about 90 days in the making of drawings and securing of material, the cars to be repaired have remained in service. The next move is then to cut these cars out of service in the yards adjacent to the shop, the number depending upon the rate established for the output. This insures the cars all being in service a maximum length of time and also being out of service for repairs the minimum length of time—the ordinary average out of service running about eight to ten days per car.

Operations Similar to New Cars

The cars cut out of service are then moved to the scrap wharf which is adjacent to the repair line, where the cutting gangs proceed to cut loose the parts to be replaced, scrap being loaded as it is cut. This insures a minimum handling of scrap. What is left of the car is then moved to the repair line and finds its way through the progressive movement similar to the new cars. When these cars are started through the progress line, the car bodies are set on temporary trucks, the regular trucks are removed and overhauled on the truck track and the replacing operation is the same as for the new cars. This insures complete and thorough inspection and repairs of the old trucks.

Informal Discussion Of Car Questions

At the May meeting of the Northwest Carmen's Association a series of questions pertaining to various car subjects was deposited in a box, drawn at random and submitted for discussion in open meeting by the car-department supervisors and car inspectors present. The discussions of some of these questions are given below, not as authoritative answers to the various points raised, but simply as the view of the association regarding a few of the many important questions which confront car men. Some questions, submitted in writing after the May meeting, were answered by the association's A.A.R. committee. Part of the questions and answers are included here. Others will appear in a later issue.

Question.—What causes waste grabs? What effect will a waste grab have on a journal and bearing? What can be done to prevent waste grabs?

O. J. Lystad (C. St. P. M. & O.)—I would say that heavy switching is one cause of it, and the effect on the journal is to heat and cut it.

D. S. Harrington (C. M. St. P. & P.)—We ought to have some discussion on this one. I have heard it discussed for years, from every possible angle. Some think that it is caused by swaying of cars on rough tracks, some think low joint or small pieces broken out of rail will cause it. While it may be possible that a low joint or piece missing from rail can cause it, I think the largest single cause is fast switching, particularly on empty cars.

I have an instance in mind which I think bears this out. A couple of years ago we were getting from one to three or four waste-grab hot boxes on every ten or less cars received from an industry located several miles from our yard. I was told these cars were handled roughly while being spotted for loading and passed the information along to my foreman, who took it up in the right quarters. The operating department seems to have co-operated, as the waste-grab hot boxes suddenly disappeared. I think it is also possible to get a waste grab when brakes are applied suddenly with cars running.

G. Schadegg (C. G. W.)—A low joint will cause a waste grab, because one pair of wheels will dip down into the low joint while the other wheel is up high. It has a tendency to raise the packing on one side and the brass will grab it. I have seen it happen, I was standing by one of these low joints when three or four heavy gondolas passed over, and one box had no cover on it. I saw the brass grab the packing and by the time this car was switched on the coal dock about a mile away it was starting to heat and the waste grab was plainly visible.

D. S. Harrington (C. M. St. P. & P.)—I have never seen an instance where I could be sure a waste grab was caused by low joint or broken rail, but have caught several immediately after rough switching.

Question.—Is the handling line justified in billing for renewal of dustguards when wheels are changed due to handling line defects—such as slid flat, etc.?

D. S. Harrington (C. M. St. P. & P.)—We have a bill clerk here, I believe, Mr. Williamson.

J. A. Williamson (C. St. P. M. & O.)—That is a no-bill.

Question.—Under what conditions is damage to an end valve on a passenger refrigerator in freight service cardable in interchange?

D. S. Harrington (C. M. St. P. & P.)—This is one for a passenger man.

A Member—I would say that is covered in Passenger Rule 8. It has to be completely missing.

D. S. Harrington (C. M. St. P. & P.)—As I understand, broken by passing coupler is a handling line defect. Passenger Car Rule 8 specifies several things—coupler passing or replaced with elbow or other fittings.

E. N. Myers (C. I. I.)—Passenger Car Rule 8 says it is cardable any time due to any Rule 8 condition, even damage due to couplers on a passenger car is cardable.

J. Chalmers (C. St. P. M. & O.)—Is it considered a passenger car regardless of the fact that it is in freight service?

E. N. Myers (C. I. I.)—Yes, a car of passenger car construction is a passenger car regardless of service it is in.

Question.—There are some cars equipped with a hook-type brake-beam hanger on which it is impossible to apply the new Ajax No. 15 brake beams without changing the hangers. Are we permitted to charge for the hangers which it would be necessary to manufacture in order to apply the No. 15 brake beam?

J. A. Williamson (C. St. P. M. & O.)—I would say yes on that. I believe it is Rule 17 that gives you permission.

Question.—When a journal-box bolt is short allowing the application of only one common nut, is this nut chargeable to the owner?

O. J. Lystad (C. St. P. M. & O.)—No. Rule 64 applies.

Questions Answered by Northwest A.A.R. Committee

Question.—Are Pennsylvania cars equipped with Type AB brakes and marked "Experimental" still considered to be experimental or should they be cleaned, oiled and tested at the expiration of 36 months?

Answer.—The original test of AB brakes on Pennsylvania cars marked AB Experimental was closed Dec. 31, 1936. The AB brakes on these cars are now handled the same as other AB brakes in accordance with Rule 60. The experience gained during these tests indicated that slight improvements could be made.

On account of these changes and to gain further information, there have been an additional lot of 699 Pennsylvania cars, No. 59065 to 59413, 59450 to 59499 and 59500-59799 also 500 A. T. & S. F. cars No. 34000 to 34499, equipped with AB brakes and stenciled AB Experimental as covered by Circulars DV 887 and DV 887-A. The AB brake equipments on these cars are to be handled the same as the experimental AB brakes.

Question.—In connection with Loading Rules, Fig. 6, covering the loading of two or more piles of lumber on flat cars, the question has come up if, with long material loaded first on a flat car about one-half way up, two distinct piles are loaded on top of this long material, 4-in. by 4-in. bearing pieces are required under the outside ends of end piles?

Answer.—The loading rules do not call for the bearing pieces on such loads.

Question.—At a certain street crossing in making the coupling, two knuckles are broken in the same car in succession in the same end of the car. Are both knuckles chargeable to the car owner?

Answer.—Yes.

Question.—Some billing departments ask to have the total length of pipe shown when the thread only is cut on the end of a train line or retainer pipe. A.A.R. Rules allow a certain charge for cutting each thread. Is it necessary to show the length of the pipe on which the thread is cut?

Answer.—Not necessary.

Question.—As air brake man, I have been finding a number of AB release-valve-handle end plates bent and release valves stuck. I believe it is due to some extent to the ½-in. heavy release rod with which these cars are equipped. I would like to know if any of the other railroads are finding the same condition.

Answer.—There have been a number of cases where the AB release-valve-handle and end plates were found bent causing release valves to stick open. This was believed due to rough handling rather than the size of the release rod.

The position of the release valve made it convenient to kick these valves open, which sometimes caused the handles and end plates to bend or break.

This condition was brought to the attention of the manufacturer and the following changes have been made: The end plate is now a one-piece steel forging with a thicker base and four spokes instead of three which will stand a pull 10 times that required to break the old type; the new handle is shortened 1⁵⁄₁₆ in. in overall length, it being claimed that the shortening of the handle reduces the force developed and provides increased force for returning the operating rod to release position.

Question.—Rule 23, Sec. 5, says: "The surface where new material is to be deposited must be clean and bright and reasonably smooth, and, therefore, if the surfaces are prepared by the burning process the surfaces must be finished by chipping before welding."

What is meant by chipping? Does a few chisel marks on the face of the cut constitute "chipping" as used in this rule? If chipping does not mean removing all of the thin film of oxidized metal covering the surface prepared by the burning process then how much of the surface must be cleared of this oxidized metal to meet the requirements of this rule?

Answer.—The surface must be entirely clean; a mere chipping is not sufficient.

Question.—It is noted that spring cotters and split keys that are undersize are being applied in journal-box lid pins, brake-hanger pins and brake-connection pins. Is the car owner being billed for such spring cotters and split keys?

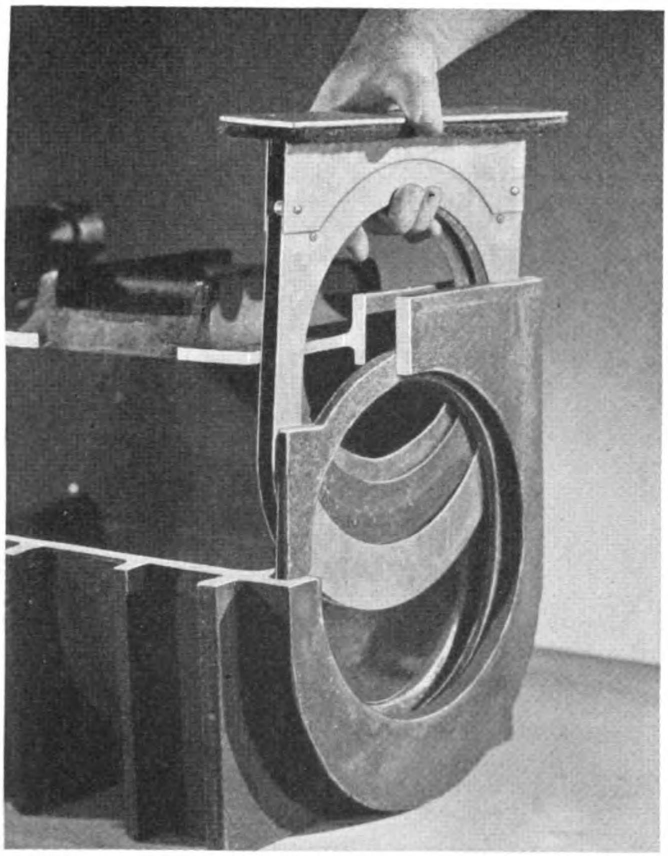
Answer.—Car owner should not be billed unless cotters and split keys are applied in accordance with Rule 64.

M-F Dust Guard

A dust guard, known as the M-F, has recently been developed and placed on the market by the MacLean-Fogg Lock Nut Company, Chicago. This guard is designed to seal effectively the well side of the journal box as well as the opening around the axle, and it closes the top of the well so that no dirt can enter and accumulate here.

The construction and method of application of this new dust guard are indicated in the illustration. The dust guard comprises three pieces; namely, a watertight steel and wool-felt gasket that keeps dirt and water out of the back of the box, irrespective of casting irregularities; a floating seal frame and flexible leather washer, encircling the axle, and a riveted pressed-steel frame within which the seal moves up and down.

When the main dust guard frame, containing the seal, is pressed down into position, it is held tightly in place against the waterproof gasket by four small flat springs which press against the side of the dust guard well. An adjustable feature permits the top of the guard, with its felt-lined under surface, to come down firmly on top of the well, regardless of well depth, and thus make an ef-



New type M-F dust guard being inserted in the dust guard well

fective and permanent well closure, irrespective of the roughness of the casting.

The floating leather washer, or seal, moves freely within the main dust-guard frame and contacts the axle with even pressure at all points, thus preventing the development of an oval opening through excessive wear. It can never contact the top of the frame nor get jammed in the dust guard well to be broken or worn by the axle. Moreover, it is said not to be susceptible to deterioration due to the action of oil or water.

The flexible leather washer normally points toward the inside of the journal box, but if it is desired to have it point toward the wheel, an expander ring can be furnished to maintain it in that position until the journal is inserted in the box.

Decisions of Arbitration Cases

(The Arbitration Committee of the A.A.R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Failure to Show Proper Description of Cause for Renewing Steam-Heat Hose

On April 19, 1934, at Denver, Colo., the Union Pacific made repairs to a Wabash (American Refrigerator Transit Company) express refrigerator car which included using the repair-card description, "A-1 new 5-ply steam hose applied." In the "Why Made" column the initials "B. O." were inserted. Charges were made for a new steam hose and the undescribed item removed was credited as a defective ordinary hose in compliance with Item 17, Passenger Car Rule 22. The car owner took exception to the credit allowance, claiming that the defective item removed was a standard metallic connector and that proper credit should have been allowed according to Item 39 Passenger Car Rule 22. Subsequently, on August 28, 1934, joint evidence was executed at Decatur, Ill., by the Wabash, and forwarded to the Union Pacific in support of the previously mentioned exception to the credit allowance and as authority to cover the adjustment of labor involved in correcting the wrong repairs.

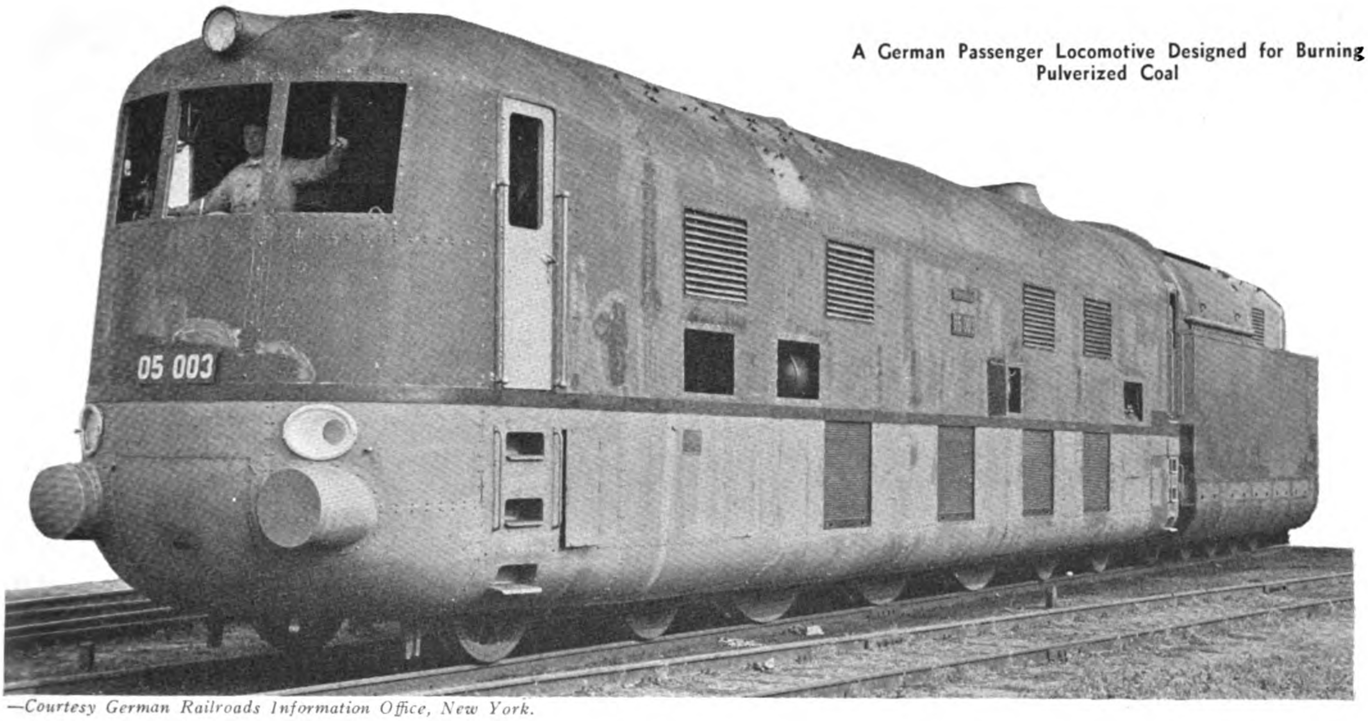
The car owner stated that the car was equipped with metallic steam connectors as a standard and was so stenciled, and that the Union Pacific, in crediting an ordinary hose, violated the A.A.R. principle established in Interpretation 1 to Freight Car Rule 8. It was further stated that no repairs had been made to the metallic connectors in the time intervening between the original standardization and the Union Pacific repairs in question. The car owner contended that the failure of the repairing line to include sufficient information on repair records to permit intelligent billing cannot be held to justify the assumption of repair information necessary to credit an undescribed part removed at $3.50 instead of an alternative $22.45. The car owner contended further that the mishandling provides no opposition to the exception based on car standard equipment supported by Interpretation 1, Freight Car Rule 8, Interpretation 3 to Passenger Car Rule 16 and, finally, joint evidence submitted in accordance with Freight Car Rules 12 and 13, supported by Passenger Car Rule 5.

The Union Pacific contended that its billing repair card complied with the requirements of Interchange Rules 7, 8 and 9 and that, except as otherwise specified, a detailed description of parts removed is not required when material is renewed in kind. The Union Pacific stated that the interchange record referred to by the car owner classifies the part in question as "hose" which term is used in Interpretation 3 to Passenger Car Rule 16 and that, in itself, fully identifies type, making the use of the word "rubber" unnecessary. The Union Pacific pointed out that the joint evidence submitted did not prove a metallic connector had been removed and therefore cannot be considered sufficient to justify a claim for credit for a metallic connector on the grounds that a joint evidence card is final. The Union Pacific stated that under rules in effect prior to Aug. 1, 1934, it is not responsible on the basis of perpetuation, and as the A. A. R. recommended-practice steam hose was a proper substitute for a metallic connector, its subsequent renewal in kind by the Union Pacific cannot be classed as wrong repairs.

In rendering a decision on November 12, 1936, the Arbitration Committee stated: "Car was received on the line of the Union Pacific April 18 and repaired April 19, 1934. At that time Passenger Car Rule 8 did not classify as delivering-line defect steam heat hose applied in place of metallic steam connector.

"No conclusive evidence is presented by car owner to substantiate statement that the Union Pacific removed a metallic steam connector, nor does the joint evidence sustain claim that car was stenciled therefor.

"However, the use of initials "B. O." cannot be accepted as proper description of cause for repairs and, for this reason, the charge for steam heat hose applied April 19, should be withdrawn."—*Case No. 1750, American Refrigerator Transit Company versus Union Pacific Railroad.*



A German Passenger Locomotive Designed for Burning Pulverized Coal

—*Courtesy German Railroads Information Office, New York.*

NEWS

German Passenger Locomotive for Burning Pulverized Coal

An express passenger locomotive having the appearance of a streamline Diesel-electric locomotive, but using pulverized coal for fuel, has recently been completed for the German Railroads by the Borsig Works, Berlin, Germany. The locomotive runs with the firebox and cab at the front end, with the tender coupled back of the smokebox. The supply of pulverized coal from the tender is automatically controlled. The locomotive has 80.6-in. driving wheels and is the first passenger type to be built in Germany for burning pulverized coal.

Report on Cooper-Nightingale Auto Loader

A "second progress report" prepared by the Division of Engineering Research of the Association of American Railroads on the Cooper-Nightingale auto loader covers the new design and present status of that device, which for the past year has been under study by the Research division in collaboration with a committee of the A.A.R. Mechanical division and other organizations. During the past two months, the report points out, the Pullman-Standard Car Manufacturing Company has made a new design of the loader for the purpose of placing it on a production basis and thereby reducing its cost.

The loader provides a means of loading four automobiles in a 40 ft. 6 in. box car. Two automobiles are supported on inclined decks while the other two rest on the floor of the box car underneath the inclined decks. New features incorporated in the Pullman design included: (a) Decks and auxiliary equipment in general made of Cor-Ten steel in form of pressings and using spot-welded connections; (b) hoists mounted on one side of the deck; (c) a new design of tie-down, which has reduced the cost of this part of the equipment; (d) a new design for indexing the front end of the deck. "In the redesign of this loader," the report states, "none of the good features of previous designs, such as safety, flexibility, ease of inspection, has been sacrificed."

D. & R. G. and Santa Fe to Rebuild Enginehouses

The *Denver & Rio Grande Western* plans to rebuild immediately its coal chute and enginehouse at Thistle, Utah, which were totally destroyed by fire above the foundations on September 17. The same fire also destroyed the combined machine shop and powerhouse at the same point. The property loss totalled about $40,000.

The Atchison, Topeka & Santa Fe.—The work, necessitated by the increased size of locomotives now in use, involves the tearing down of nine stalls of the enginehouse and the reconstruction of six stalls and a machine shop. The new stalls will be 132 ft. long and will be constructed of structural steel encased in concrete, with brick curtain walls. Because of the necessity of placing the enginehouse in operation at the earliest possible date, the construction work is being carried out by two shifts daily.

Building Program of the L.M.S.

The London, Midland & Scottish (Great Britain) is engaged in an extensive building program in both rolling-stock and structures. Equipment plans of the road call for the construction of 1,160 freight cars, comprising 500 twenty-ton ore cars, 650 merchandise box cars and 10 eight-wheel heavy-duty units.

A new modern coach shop and sidings, designed to augment the existing facilities at Euston station, London, and estimated to cost £500,000 ($2,480,000), marks the first step in a long-term plan to reconstruct the famous London terminal. The new shop, which will be fully equipped for vacuum-cleaning, steam-heating and battery charging, will provide accommodations for 600 coaches, with facilities for preparing, under cover, 200 coaches at a time. The first locomotive testing plant in Britain is now under construction jointly by the L. M. S. and the London & North Eastern at Rugby.

Steam Locomotive Development Committee Appointed

Relatively few changes in the personnel of standing committees of the A.A.R. Mechanical Division are shown in Circular No. D.V.-925, recently issued by the secretary's office, with the exception of the appointment of a special committee on "Further Development of Reciprocating Steam Locomotives." The membership of this committee includes: Chairman D. S. Ellis, chief mechanical officer, Chesapeake & Ohio, Cleveland, Ohio; Vice-Chairman W.

I. Cantley, mechanical engineer, Lehigh Valley, Bethlehem, Pa.; W. R. Hedeman, assistant to chief of motive power and equipment, Baltimore & Ohio, Baltimore, Md.; J. E. Davenport, assistant chief engineer of motive power and rolling stock, New York Central, New York; W. R. Elsey, mechanical engineer, Pennsylvania, Philadelphia, Pa.; J. M. Nicholson, acting mechanical superintendent, Atchison, Topeka & Santa Fe, Topeka, Kan.; Lawford H. Fry, railway engineer, Edgewater Steel Company, Pittsburgh, Pa.; W. E. Woodard, vice-president, Lima Locomotive Works, Inc., New York; H. Glaenzer, vice-president, Baldwin Locomotive Works, Philadelphia, Pa.; J. B. Ennis, vice-president, American Locomotive Company, New York; E. G. Bailey, vice-president, Babcock & Wilcox Company, New York; and Edward C. Schmidt, professor of railway engineering, University of Illinois, Urbana, Ill.

Head Freight Brakemen to Ride Cushions; and Have Heaters

HEAD brakemen on freight trains will henceforth ride in heated quarters fitted with spring cushion seats with arm and back rests, as a result of an agreement announced on October 13 between the Brotherhood of Railroad Trainmen and the Association of American Railroads.

The joint statement in this connection from A. F. Whitney, president of the B.R.T., and J. J. Pelley, president of the A.A.R., says that under the agreement, effective November 1, "spring cushion seats with arm and back rests will be provided head brakemen and will be installed on locomotives used for freight service, combination freight and passenger service, and combination freight and helper service. Such a seat either will be installed in the locomotive cab or in a shelter cab placed on the tender of the locomotive, the location being optional with the railroad. Heaters are also to be provided in the shelter cabs in territories where necessary.

"The railroads are allowed five years in which to install such seats in locomotives coming under the agreement. All new locomotives covered by the agreement, however, will be equipped when built.

"The negotiations between the trainmen and the railroads resulted from a complaint filed by the former with the Interstate Commerce Commission in an effort to have an order issued requiring that such seating facilities be furnished by all railroads. As a result of the agreement the Brotherhood of Railroad Trainmen has asked the commission to dismiss the complaint."

P & S Division Selects Committees

THE Purchases and Stores division, A.A.R., has announced the selection of subjects for study this year and a tentative list of the committee membership. Five new subjects, Special Purchasing Statistics; Efficient Methods of Transporting Company Materials and Prompt Unloading of Equipment; Receiving Records; Stores Organization, Office Practices and Records, and Quantity Price Differentials have been selected, and three committees, Purchasing and Store Department Manual; Shop Manufactured Materials, and Terminal Railway Storekeeping, have been revived. An advisory committee consisting of the past chairmen of the division, under the chairmanship of E. A. Clifford, general purchasing agent, C. & N. W., and a special purchasing committee consisting of nine purchasing officers, under the chairmanship of A. C. Mann, vice-president, I. C., have been continued, as well as the so-called group organization for holding purchasing and stores meetings in different territories. New chairmen have been selected for all committees, with the exception of the committees on scrap handling, general reclamation, stores expense, forest products, fuel, stationery and printing and simplification. The appointments to some of the new and re-organized special and subject committees are as follows:

Railroad Scrap: W. J. Sidey, supervisor scrap and reclamation, L. V., chairman; E. J. Becker, district storekeeper, S. P.; D. D. Canavan, general foreman reclamation plant, B. & M.; J. J. Collins, supervisor scrap and reclamation, Erie; J. T. Goodloe, division storekeeper, Southern; R. R. Kane, division storekeeper, L. & N.; C. L. McIllvaine, assistant purchasing agent, Penna.; C. E. Reasoner, assistant district storekeeper, M-K-T; T. H. Ryan, assistant purchasing agent, Wabash; J. A. Sims, care purchasing department, C. & N. W.; H. E. Warren, manager purchases and stores, G. M. & N.; J. C. Kirk, assistant general storekeeper, C. R. I. & P., chairman ex-officio.

General Reclamation (Joint with Mechanical and Engineering divisions): A. L. Prentice, manager scrap and reclamation, N. Y. C., chairman; I. C. Bon, superintendent scrap and reclamaation, Wabash; E. R. Casey, superintendent reclamation, Union Pacific; R. E. Hamilton, supervisor reclamation, C. & O.; T. J. Hegeman, superintendent scrap and reclamation, C. B. & Q.; W. P. Stewart, supervisor scrap and reclamation, I. C.; Peter Young, superintendent of reclamation, A. T. & S. F.; J. C. Kirk, assistant general storekeeper, C. R. I. & P., chairman ex-officio.

Pricing Methods: G. J. Hunter, traveling material supervisor, A. T. & S. F., chairman; N. B. Coggins, division storekeeper, C. N. O. & T.; L. L. Studer, division storekeeper, M. P.; G. E. Tallmadge, assistant general storekeeper, G. N.; E. G. Walker, assistant general purchasing agent, A. T. & S. F., chairman ex-officio.

Shop Made Materials: B. T. Adams, district storekeeper, I. C., chairman; R. W. Hall, division storekeeper, L. & N.; A. N. Laret, assistant to chief purchasing officer, St. L.-S. F.; W. L. Oswalt, works storekeeper, Penna.; C. J. Vanderbosch, district storekeeper, B. & O.; L. P. Krampf, supply agent, M. P., chairman ex-officio.

Material Handling: A. S. McKelligon, general storekeeper, S. P., chairman; J. M. Lowe, storekeeper, N. & W.; J. V. Miller, assistant general storekeeper, C. M. St. P. & P.; H. E. Ray, general storekeeper, A. T. & S. F.; W. F. Redman, traveling storekeeper, C. & N. W.; H. M. Smith, general storekeeper, N. P.; S. P. Warmack, general storekeeper, I-G N.; G. M. Betterton, purchasing agent, S. P., chairman ex-officio.

Terminal Storekeeping: J. K. McCann, inspector of stores, C. B. & Q., chairman; R. H. Bruckert, storekeeper, Ky. & Ind. Term'l; A. F. Campbell, general storekeeper, Ill. Terminal; F. A. Murphy, district storekeeper, B. & O.; H. A. Smith, purchasing agent, Term'l R. R. Ass'n St. L.; C. W. Yeamans, purchasing and supply agent, C. & W. I.; L. P. Krampf, supply agent, M. P., chairman ex-officio.

Equipment Depreciation Orders

DEPRECIATION rates applicable to the equipment of 12 roads are prescribed by the Interstate Commerce Commission in a recently issued series of sub-orders and modifications of previous sub-orders in No. 15100, Depreciation Charges of Steam Railroad Companies. The composite percentages, which are not prescribed rates but merely the averages of such, range from 2.84 per cent for the Lorain & Southern to 8.82 per cent for the East Washington.

The largest of the 12 roads is the Gulf, Mobile & Northern, the rates for which are prescribed in a sub-order modifying a previous sub-order. Its composite percentage is 4.25 per cent derived from the following prescribed rates: Steam locomotives—owned, 4.13 per cent; steam locomotives—leased, 4.56 per cent; freight cars—owned, 3.75 per cent; freight cars—leased, 7.48 per cent; passenger cars in streamlined trains, 6.53 per cent; other passenger cars owned, 4.55 per cent; passenger cars—leased, 13.01 per cent; work equipment—owned, 3.03 per cent; work equipment—leased, 7.72 per cent; miscellaneous equipment, 24.36 per cent.

Shippers' Advisory Board Discusses Car Construction

AT the forty-fourth regular meeting of the Atlantic States Shippers' Advisory Board, held in the Hotel Robert Treat, Newark, N. J., October 6 and 7, a detailed report was presented by the committee on car construction, under the chairmanship of C. J. Fagg, manager, Commerce & Trade Bureau, Chamber of Commerce of Newark. Among the quotations given from the proceedings of other advisory boards concerning car construction was the statement that "it is our belief that the railroads alone are the best judges as to

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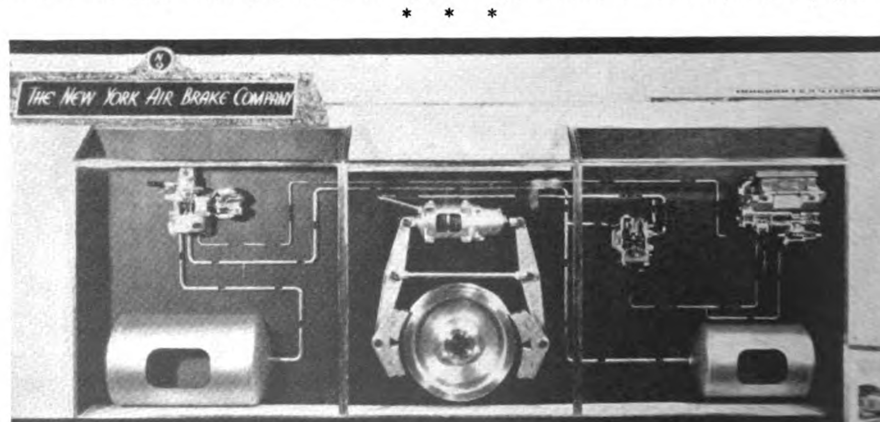

A high-speed train brake working model recently installed at the New York Museum of Science and Industry. (Described in the October issue of the *Railway Mechanical Engineer*, page 506)

what cars are required in number and type to properly serve the requirements of the shippers on their respective roads. Varied commodity production necessitates different types and sizes of cars; both our steel and lumber people are constantly advocating the superior quality of their respective products for car construction, and were we to initiate a survey [among shippers] the responses would be more conflicting than helpful."

Commenting upon this, however, the report suggested that "there is laxity on the part of the railroads in not fully informing shippers, as a whole, regarding new equipment; that some railroads are building improved types of equipment and such progress is not being followed by others in a uniform way." The report added: "Your committee is still without information from the carriers as to what method or plans they are following with respect to co-operation with the shippers in creating a change in their equipment or ascertaining the needs of shippers in order to increase their loading, hold and retain their markets and encourage the movement of such commodities by rail."

With respect to the increasing construction of special-type cars, the committee held the opinion that such specialization provides a load only in one direction which appears to the group to impose upon the majority of shippers an unfair burden of transportation costs. This characterization, the committee did not apply to the recently-introduced "removable roof box car," however, averring that, since "the new equipment affords heavier loading and is of such construction, it may be used in general service, eliminating unreasonable transportation costs resulting from inability to get a return load. Carriers should especially study this feature in co-operation with the shipper before adopting specialized equipment," the report added.

The remainder of the report was taken up with a survey of comments received from shippers since a meeting on April 8. Several furnish vigorous backing of the committee's own opposition to over-specialization in car types. Another presents reasons for the adoption of a standard-size box car by the carriers, to be assigned a length of 36 ft. 6 in., holding that shippers be granted the privilege of partial loading or unloading in transit. Such a measure, the comment holds, is dependent upon the application of the same minimum weight, regardless of the size of the car, and the basing of such minimum on the actual loading capacity of a 36-ft. car for each commodity listed in the classification. In support of such a measure the comment points out that "the tendency today seems to be to ship in relatively small quantities, so that a car of 36 ft. 6 in., together with the privilege of partial loading or unloading in transit, should answer the purpose."

In closing, the committee complained that the carriers, failing to ascertain the real needs of shippers, were in many cases building the wrong type of equipment. "It is the observation of your committee that too many railroads are building equipment they believe will be operated solely on the owners line, however, necessity oftimes requires interline movement. This means, therefore, that special equipment is a national problem."

The Board estimated, for the territory within its jurisdiction, an 11.4 per cent increase in carloadings for the fourth quarter of this year as compared with the corresponding period of 1936. This figure was ascertained on the basis of reports delivered by 40 commodity committees, which estimated that the number and kind of cars required through October, November and December would total 701,287, as compared with a record of 629,701 carloads shipped during the identical period of last year.

Speaking on "Possible Legislative Interference with Efficient and Economical Operation of Railroads," M. J. Gormley, executive assistant to the president, Association of American Railroads, argued before the members of the board at the October 7 session that there is no justification for the train-limit bill now pending, expressing the fear that the bill, in its consideration by the House of Representatives, will be treated from a political standpoint. Mr. Gormley also pleaded for strong action against the counter proposal that the power to regulate the length of trains be delegated to the Interstate Commerce Commission, asserting that "the railroads now have all the regulation they can stand and Congress should not interfere with a managerial function of this kind by the passage of a law or by delegation of power to the Commission."

Equipment Building and Repair Programs

The Virginian placed orders recently covering repair material for approximately 800 of its 120-ton gondola cars which the railroad company expects to repair in its own shops at Princeton, W. Va. This is a continuation of a program inaugurated about two years ago covering repairs to a large quantity of its coal-carrying cars.

The Chicago, Burlington & Quincy has announced plans for the expenditure of $4,888,000 for the purchase of locomotives and freight and passenger cars. As soon as arrangements have been made for the sale of the necessary equipment trust notes, which will total $3,650,000, formal inquiries will be issued for 100 Hart ballast cars, 3 stainless-steel dining and 3 stainless-steel chair cars for the "Aristocrat," 2 stainless-steel dinette-coaches and 2 stainless-steel sleepers for the Denver "Zephyrs," and 1 stainless-steel dinette-coach car with kitchen for the original "Zephyr." In addition to these cars, the equipment trust notes will cover equipment to be built in company shops, including 5 locomotives; 250 automobile cars, 100 of which will be equipped with automobile loading devices; 600 box cars; 100 hopper cars; and 400 coal cars, including 100 55-ton cars and 300 50-ton cars.

Supply Trade Notes

F. O. SCHRAMM, manufacturers' representative, 11 W. 42nd Street, New York, has added to his accounts representation of the Grinder division of the Hammond Machinery Builders, Inc., Kalamazoo, Mich.

W. E. CADE, JR., and T. F. DWYER, JR., have formed the Cade-Dwyer Company, 683 Atlantic avenue, Boston, Mass., for the continuance of the business established by the late F. A. Barbey, with whom they were associated for years.

GEORGE S. CASE, JR., vice-president and general manager of the Lamson & Sessions Company of Chicago, has been elected vice-president and general manager of the Lamson & Sessions Bolt Company, Birmingham, Ala., to succeed H. P. Ladds, resigned. Mr. Case has been succeeded by William M. Olsen, manager of the stove bolt and machine screw sales department of the Lamson & Sessions Company of Cleveland, Ohio. Mr. Olsen has been succeeded by G. Rider Neff of the sales department at Cleveland. Alexander M. Smith, who has been in charge of the experimental and development department, has been appointed to assistant general manager of the Lamson & Sessions Company of Chicago.

THE ELECTRO METALLURGICAL COMPANY, unit of Union Carbide and Carbon Corporation, New York, proposes to locate a new plant in the Wilson dam, Alabama, area. The plant will be constructed principally for the manufacture of ferro-alloys, calcium carbide, and other electric-furnace products.

W. C. REID, midwestern manager at Chicago of the Matallizing Engineering Company, Inc., has been appointed vice-president in charge of sales, with headquarters at the main office in New York City. Walter B. Meyer, manager of the St. Louis, Mo., office, has been appointed manager of the Chicago office, and Alan B. Geuder, connected with the Chicago office as a salesman, takes over Mr. Meyer's duties in St. Louis.

GEORGE H. CORLISS, advertising and sales promotion manager for the past four years for the Lewis-Shepard Company, Boston, Mass., has been appointed regional manager for the company, with headquarters at 1401 Santa Fe avenue, Los Angeles, Cal. Mr. Corliss was formerly associated with the S. A. Woods Machine Company, Boston; J. A. Fay & Egan Company, Cincinnati, Ohio, and the Kewaunee Mfg. Co., Kewaunee, Wis.

GUSTAV LAUB, general manager of sales, of the Vanadium Corporation of America, New York, has been appointed assistant vice-president and general manager of

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sales. Mr. Laub is a graduate of the University of Pittsburgh. He became associated with the American Vanadium Corporation, Pittsburgh, Pa., in 1916. After this organization was absorbed by the Vanadium Corporation of America in 1920,

Gustav Laub

he was transferred to the Primos Chemical Company, another Vanadium acquisition, and was later placed in charge of mining properties of the corporation in Colorado. In 1921, he went to the New York office of the Vanadium Corporation of America, and subsequently served as assistant secretary, and assistant general manager of sales. He became general manager of sales in 1931.

The Unit Truck Corporation, 15 Exchange Place, Jersey City, N. J., has recently been incorporated to introduce the "Unit Truck" to the railway trade. The officers and directors of the new company are: Lester A. Crone, president; Alfred F. Crone, vice-president, and Charles R. Busch, vice-president, all of whom are connected with the Buffalo Brake Beam Company.

Lester A. Crone, president of the Unit Truck Corporation, was born on July 25, 1902. He was educated in the public school, East Orange High School, Stevens Preparatory School and Stevens Institute of Technology, receiving the degree of mechanical engineer in the class of 1926. Mr. Crone became assistant to the president of the Buffalo Brake Beam Company in 1926; in 1934, vice-president, and in 1936, president. He will continue in the presidency of the Buffalo Brake Beam Company while serving also as president and director of the Unit Truck Corp.

Alfred F. Crone, vice-president of the Unit Truck Corporation, was born on September 24, 1907, and was educated in the public school, East Orange High School and Stevens Preparatory School. He was a metallurgist in the employ of the Acme Steel & Malleable Iron Works, Inc., from 1927 to 1934. He then became assistant to the president of the company. In 1935 he was appointed assistant to president of the Buffalo Brake Beam Company. This year (1937) he became vice-president of the Buffalo Brake Beam Company, and now becomes also vice-president of the Unit Truck Corporation.

Charles R. Busch, vice-president of the Unit Truck Corporation, was born on January 29, 1892, at Springfield, Mo., and was educated in the public and high schools of Springfield. In 1909 he was material accountant of the Southern Pacific of Mexico at Tucson, Ariz., and two years later became traveling accountant. In 1912 he became stock clerk to the section foreman of the St. Louis-San Francisco; in 1913, foreman of the car material general storehouse at Springfield, and from 1914 to 1917 was foreman and chief clerk of the Frisco reclamation plant at Springfield. In 1918 he was appointed stationery storekeeper of the Seaboard Air Line at Portsmouth, Va., and during 1919 and 1920 was assistant general storekeeper at Portsmouth. In 1920 Mr. Busch became sales representative, eastern and southern districts, of the Buffalo Brake Beam Company, with headquarters at New York. He continues also in this position.

Craig W. Marshall has been appointed manager of railway sales of the United States Gypsum Company, with headquarters at the company's main office, Chicago.

Craig W. Marshall

Mr. Marshall, who will direct all sales to the railroads of United States Gypsum Company products, began his railroad experience early as an apprentice machinist with the Union Stock Yards Railroad Company. He then attended the University of Valparaiso, Carnegie Institute of Technology, and Ohio Northern University, completing a course in civil and mechanical engineering. Shortly after leaving school Mr. Marshall entered the army as a lieutenant in the Engineer Corps. Following his discharge from the army he was employed by the Concrete Steel Company, Chicago, and soon became assistant western manager, continuing in that capacity until 1922, when he joined the American Arch Company, as district manager of the industrial department. In 1925 he was appointed eastern sales manager of the Sunbeam Electric Manufacturing Company, and continued in that capacity for nearly eleven years.

James A. Slater has been elected a director of the National Malleable & Steel Castings Company, Cleveland, Ohio, to fill the vacancy on the board caused by the death of Oliver W. Loomis on August 19. Mr. Slater is vice-president of the company in charge of railway sales. He was first employed by the National Malleable Castings Company, a predecessor of the present company, in 1897, and served in various capacities prior to 1913, when he went to Chicago as manager of railway sales in that territory. He returned to Cleveland in 1921 and, continuing in sales work, was elected assistant vice-president in 1931 and vice-president in 1934.

The Texas Company, New York, has made the following appointments in its railway traffic and sales department: W. E. Greenwood has been appointed general manager, Charles Ervin has been appointed traffic manager, and J. L. Lavallee has been appointed sales manager, all with headquarters in the Chrysler building, New York. J. M. P. McCraven has been appointed district manager, railway sales division. Edward Wegner has been appointed assistant district manager, railway sales division, both with headquarters in the McCormick building, Chicago, and A. W. Larsen has been appointed assistant district manager, railway sales division, with headquarters at 1218 Olive street, St. Louis, Mo.

Obituary

Alan Nelson Lukens, inventor and chief mechanical engineer of the Railway Steel Spring Division of the American Locomotive Company for about 50 years, died at his home on October 19 at Elizabeth, N. J., at the age of 70 years. Mr. Lukens was born on March 29, 1867, at McKeesport, Pa. He received his education at Pingry School and Stevens Institute of Technology. He entered business in Philadelphia with the Scott Spring Company about 1895, being transferred to New York and becoming chief engineer when the Scott Spring Company was consolidated with the Railway Steel Spring Company. He continued as chief engineer of the Railway Steel Spring Division of the American Locomotive Company when the Railway Steel Spring Company was absorbed by the American Locomotive Company. Mr. Lukens was well known in

A. N. Lukens

railway circles and was a pioneer in many of the developments in the spring industry. He was a member of the American Society of Mechanical Engineers and the American Society for Testing Materials.

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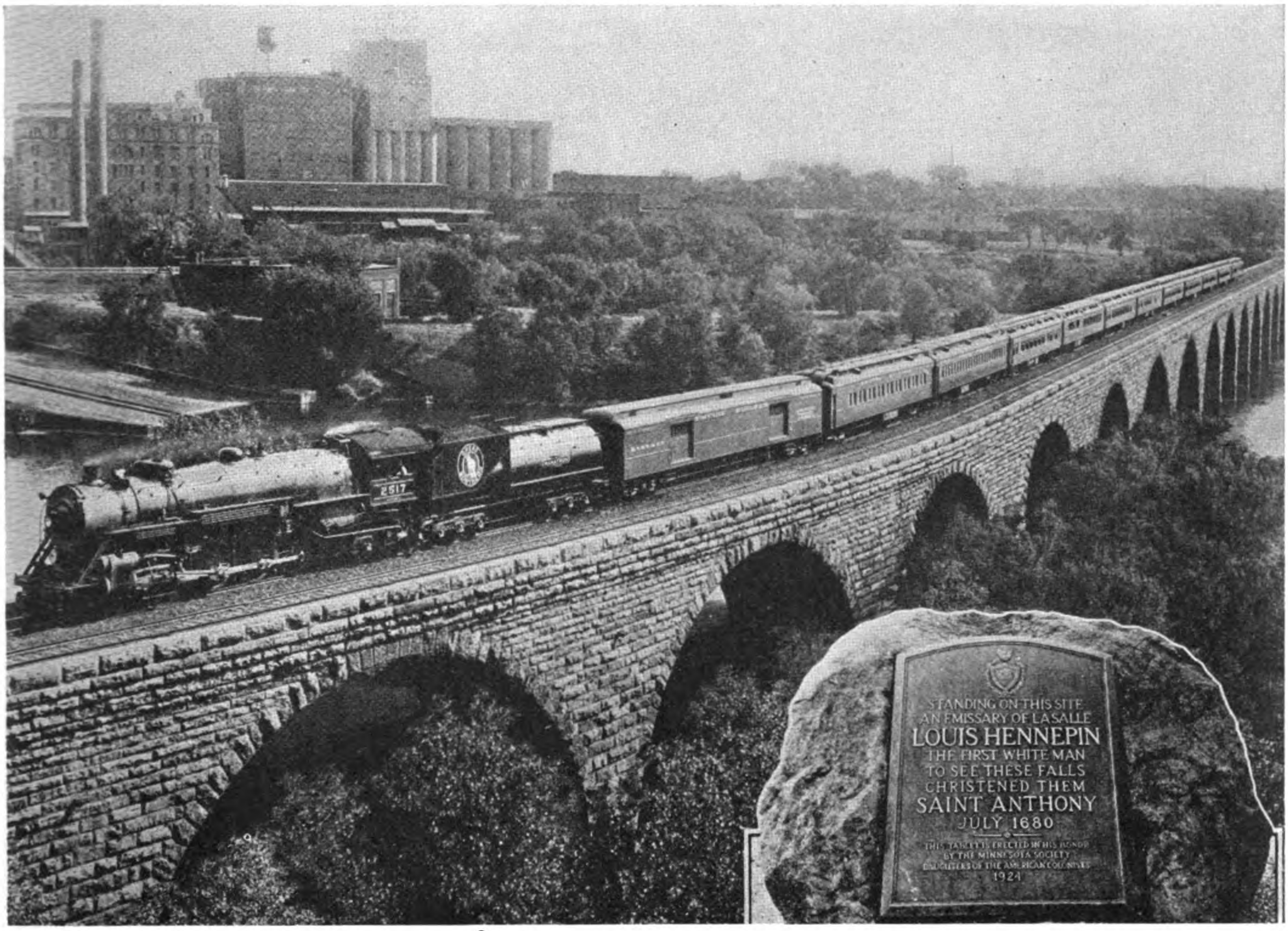
NO. 8 OF A SERIES OF FAMOUS ARCHES OF THE WORLD



THE GREAT NORTHERN BRIDGE AT MINNEAPOLIS

This photograph shows the Great Northern's crack train, the Empire Builder, crossing the Mississippi River over the famous stone arch bridge at Minneapolis. Near the east end of this span is a monument with the following inscription: "Standing on this site Louis Hennepin, the first white man to see these falls, christened them Saint Anthony." The harnessing of this water power was responsible for the growth of the little town of St. Anthony into the present city of Minneapolis. One of the flour mills for which the city is famous is seen in the background.

The bridge, with its massive masonry, lofty arches, and graceful curvature, recalls the solidity of the work of Roman antiquity. It is one of the finest stone viaducts in the world. Because of the length and curvature of the span passengers can see the bridge, and its height also commands a view of the city's skyline.

It consists of 23 arches and is 2,100 feet long, 76 feet high and 28 feet wide. Completed in 1893, it is the only structure on the Great Northern Railway on which is inscribed the name of the founder of the system, James J. Hill, who later became famed as the Empire Builder.

The locomotive shown was the first to make a round trip between the Mississippi River and the Pacific Ocean without a stop except to change engineers and take on water and fuel oil. In one direction it pulled the fast mail train; in the other a silk special. In honor of this 3,700-mile jaunt the name Marathon was assigned in place of No. 2517.

Personal Mention

General

E. E. Machovec, mechanical superintendent of the Atchison, Topeka & Santa Fe, Southern district, Western lines, with headquarters at Amarillo, Tex., has assumed also the duties of master mechanic of the Plains division of the Panhandle & Santa Fe.

J. D. Muir has been appointed superintendent of motive power and car department of the Canadian Pacific, with headquarters at Toronto, Ont., succeeding Geo. Whiteley, deceased. Mr. Muir entered the service of the Canadian Pacific in 1905 as a machinist at Moose Jaw, Sask. In 1909 he became shop foreman at Moose Jaw and in 1910 shop foreman at Calgary. He was locomotive foreman successively at Calgary, Alta., Medicine Hat, Alta., and Winnipeg, Man., from 1910 to 1916. In 1917 he became general foreman motive power department, at Vancouver, B. C., and in February, 1919, assistant works manager at Angus shops, Montreal. In 1928 he was appointed assistant superintendent motive power and car department, Western lines, with headquarters at Winnipeg, although for a time in 1933, during the illness of the late George Whiteley, he was acting superintendent motive power and car department for the Eastern lines.

J. D. Muir

Frank Sheppard Robbins, who has been appointed superintendent motive power of the Atlantic Coast Line at Wilmington, N. C., as noted in the October issue of the *Railway Mechanical Engineer,* was born on December 22, 1880, at Menantico, N. J. In March, 1900, he entered the service of the Pennsylvania as a machinist apprentice in the Meadows shops and in September, 1902, was furloughed to enter Purdue University, from which he was graduated in June, 1906, with a B.S. degree in mechanical engineering. In March, 1907, he completed his apprenticeship at the Altoona, Pa., shops of the Pennsylvania, then taking over special duties in the locomotive test plant and in studies of fuel and tonnage problems. From March to May, 1908, he was furloughed for service with the Berwind White Coal Company. In May, 1908, he became fuel inspector of the Cresson division of the Pennsylvania, and in November, 1908, shop inspector at Renovo, Pa. In November, 1909, Mr. Robbins was appointed assistant master mechanic, locomotive and car repairs, of the Monongahela division and in January, 1911, became assistant road foreman of engines of the Renovo division. He became assistant general foreman of the Pitcairn, Pa., car shop in December, 1913, and assistant master mechanic of the Pittsburgh division in July, 1914. In May, 1917, he was furloughed for military service and in March, 1919, returned to the Pennsylvania as assistant engineer of equipment, office of the assistant to president at Philadelphia, Pa. He became master mechanic of the Pittsburgh division in December, 1919, and in March, 1920, was appointed to a similar position on the Pittsburgh Terminal division. In March, 1921, Mr. Robbins resigned from the Pennsylvania and in May of that year became mechanical advisor of the Inter-Allied Technical Board, Trans-Siberian Railways, at Harbin, China. In December, 1922, he became railway representative of the Pittsburgh Testing Laboratory and in August, 1924, manager of its Philadelphia office. He was appointed superintendent motive power and machinery of the Florida East Coast at St. Augustine, Fla., in May, 1926, which position he held until his recent appointment as superintendent motive power of the Atlantic Coast Line.

F. S. Robbins

E. G. Bowie, works manager of the Ogden shops of the Canadian Pacific at Calgary, Alta., has been appointed assistant superintendent of motive power, with headquarters at Winnipeg, Man., to succeed J. D. Muir.

Master Mechanics and Road Foremen

W. Alexander has been appointed master mechanic of the Portage-Brandon division of the Canadian National, with headquarters at Winnipeg, Man., to succeed A. Mays, deceased.

Leland T. Fife, who has been appointed master mechanic of the San Joaquin division of the Southern Pacific, with headquarters at Bakersfield, Calif., as noted in the September issue of the *Railway Mechanical Engineer,* was born on July 29, 1887, at Ogden, Utah. He obtained his education in the public schools of Ogden and through a correspondence school course. He entered the employ of the Southern Pacific in July, 1905, and until July, 1907, served as an engine wiper, a machinist helper and an electric craneman. He then became, until July, 1911, a machinist apprentice at Ogden. From January, 1912, to September, 1912, he was a machinist and night foreman for the Utah Copper Company at Arthur, Utah; from October, 1912, to March, 1913, a machinist on the Chicago, Milwaukee & St. Paul; from October, 1913, to May, 1914, machine shop foreman, Utah Copper Company, Magna, Utah, and from July, 1921, to December, 1921, a machinist on the Union Pacific at Provo, Utah, and North Platte, Neb. From December, 1921, until his appointment on August 1, 1937, as master mechanic of the San Joaquin division, he has been in the service of the Southern Pacific successively as a machinist, erecting foreman, departmental foreman, general foreman, and assistant master mechanic.

L. T. Fife

C. D. Smith has been appointed master mechanic of the Port Arthur division of the Canadian National, with headquarters at Sioux Lookout, Ont., to succeed T. R. Currie, who has been transferred.

C. E. Plott, assistant master mechanic of the Galesburg-Ottumwa divisions of the Chicago, Burlington & Quincy at Galesburg, Ill., has been appointed to master mechanic of the Beardstown division, with headquarters at Beardstown, Ill.

Don Nott, master mechanic of the Beardstown division of the Chicago, Burlington & Quincy at Beardstown, Ill., has been transferred to the Casper division, with headquarters at Casper, Wyo., to succeed C. O. Davenport, deceased. Mr. Nott will have jurisdiction also over the Sheridan division.

(Turn to next left-hand page)

J. P. Kelly, master mechanic of the British Columbia district of the Canadian Pacific at Vancouver, B. C., has been appointed works manager of the Ogden shops at Calgary, Alta., succeeding E. G. Bowie.

G. R. Miller, master mechanic of the Plains division and of the Pecos division of the Panhandle & Santa Fe, with headquarters at Clovis, N. M., is confining his jurisdiction to the latter division.

Arthur J. Pentland, division master mechanic of the Canadian Pacific at Kenora, Ont., has been appointed master mechanic of the Saskatchewan district, with headquarters at Moose Jaw, Sask.

E. W. Fritts, road foreman of engines of the Hannibal division of the Chicago, Burlington & Quincy, has been promoted to the position of assistant master mechanic of the Galesburg-Ottumwa divisions at Galesburg, to succeed C. E. Plott.

G. H. Nowell, master mechanic of the Saskatchewan district of the Canadian Pacific, at Moose Jaw, Sask., has been transferred as master mechanic to the British Columbia district, with headquarters at Vancouver, B. C.

Shop and Enginehouse

Moses Harry Westbrook, superintendent of shops of the Grand Trunk Western, who retired on September 1, as noted in the October issue of the *Railway Mechanical Engineer,* was born on May 23, 1868, at Writtle, England. He received his education in the public and night schools of Canada, England and the United States. Mr. Westbrook served his apprenticeship at Robert Whitelaw's General Machine Shop, Woodstock, Ont. He later spent two years in England and Scotland, working at the government arsenal at Woolwich; Peter Denny's Marine Works, Scotland; Dryden & Forch Printing Press Works, London, and Maxim Nodenfeldt Gun Works, Erith, England. Returning to Canada, he entered the employ of the Grand Trunk Railway System at Stratford, Ont., on October 28, 1890, serving successively as a machinist, charge hand, and apprentice instructor at Stratford until April 1, 1903, when he was transferred to Port Huron, Mich., as machine shop foreman. On October 1, 1908, he was transferred as machine shop foreman to Battle Creek, Mich. In 1916 he was drafted by the Munitions Board of Canada and for several months superintended shell manufacture at the plant of the Spartan Company, Montreal. Returning to Battle Creek, he became erecting shop foreman on April 1, 1917; general foreman on January 1, 1918, and shop superintendent on November 1, 1919.

Oct., 1890

Sept., 1937

M. H. Westbrook

Trade Publications

Copies of trade publications described here can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

Turret Lathes.—The new Gisholt improved 3AL, 4L and 5L heavy duty turret lathes and optional special attachments are described in the catalog issued by the Gisholt Machine Company, Madison, Wis.

Pipe Repair Clamps.—The Pipe Repair Handbook issued by the M. B. Skinner Company, South Bend, Ind., describes how to repair various kinds of leaks without shutdown of the pipe line.

Ingersoll Ray Blade.—The features of standardization and application of the Ingersoll Ray Blade are described in detail in the eight-page illustrated Ray Blade cutter bulletin issued by the Ingersoll Milling Machine Company, Rockford, Ill.

Landis Threading Equipment.—The Landis Machine Company, Inc., Waynesboro, Pa., has issued a 16-page bulletin showing how Landis pipe threading and cutting machines cover the requirements for thread-cutting equipment in railroad shops and associated metal-working industries.

Whiting Specialties. — "Pointing the Way to Lower Repair Costs" is the title of Bulletin No. 220 issued by the Whiting Corporation, Harvey, Ill. In this bulletin are briefly described the advantages of various whiting railroad specialties—Model "B" drop tables; locomotive spotters; automatic car washers; electric turntables; cranes, etc.

Forged Steel Flanges.—The Kropp Forge Company, 5301 West Roosevelt Road, Chicago, in its four-page bulletin covers its line of forged steel stock flanges which includes boiler, tank, welding, offset, double hub, etc.

Air-Brake Devices.—Circular Notices Nos. 1111, 1112, and 1113, issued by the Westinghouse Air Brake Company, Wilmerding, Pa., describe, respectively, a cleaning device for AB valve brake pipe strainers; a new double locking angle cock and an improved handle for angle cock, and improved hose fittings.

Temperature Measurement and Control.—The Leeds & Northrup Company, 4934 Stenton avenue, Philadelphia, Pa., in Broadside N-33 on Micromax and other pyrometers, presents four distinct methods of temperature measurement and control—thermocouple pyrometers, resistance thermometers, optical pyrometers, and Rayotube pyrometers, the latter being described as offering full reliability and low maintenance in certain applications within the range of 300 deg. to 5,000 deg. F.

Signal Foam-Meter.—Bulletin No. 376 of the Electro-Chemical Engineering Corporation, 310 South Michigan avenue, Chicago, describes the Signal Foam-Meter electromatic blowoff system. A diagram shows the application of the steam separator system, and boiler cross-sections, in color, show the behavior of boiler water under average operating conditions.

Color and Design.—"Color and Design in Passenger Equipment" is the title of a 26-page brochure issued by the Pullman-Standard Car Manufacturing Company, Chicago, which illustrates the special service provided by this company in executing the interiors and exteriors of passenger cars and trains. According to the brochure this service is complete, embracing architectural features, colors, decorations, fabrics, floor coverings and other details of the finished job. The brochure, printed in colors, gives a striking impression of what has been accomplished with modern materials, fabrics and colors in most of the recent new trains and cars "styled" by Pullman-Standard. The trains illustrated include the Union Pacific "City of Denver," the Illinois Central "Green Diamond," the Southern Pacific "Daylight," the Pullman articulated cars "Advance" and "Progress," as well as some of the cars in the new 14-car streamliners which are being built for the Chicago & North Western, the Union Pacific and the Southern Pacific.

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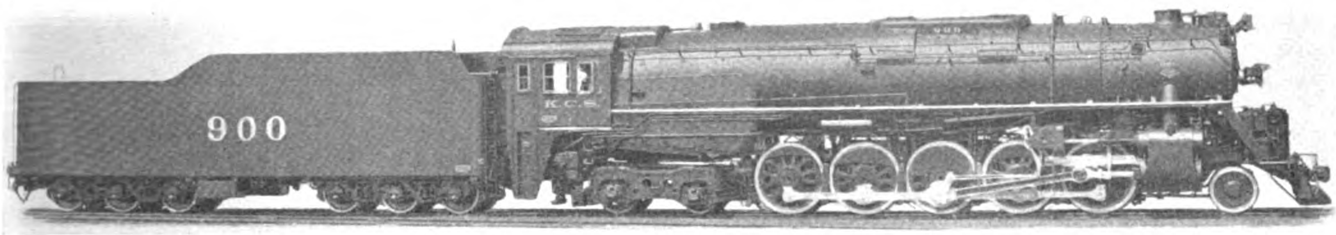
RAILWAY
MECHANICAL ENGINEER



One of the oil-burning 2-10-4 type locomotives built by the Lima Locomotive Works, Inc., for the Kansas City Southern

Kansas City Southern

Freight Locomotives

Ten 2-10-4 type built by Lima develop a tractive force of 93,300 lb.—The boiler pressure is 310 lb. and there are 7,229 sq. ft. of combined heating surface—Five burn oil and five burn coal

THE Kansas City Southern received ten freight locomotives of the 2-10-4 type from the Lima Locomotive Works during the latter part of the summer, five of which were equipped for burning oil and five for burning coal. Neither in point of total weight, weight on drivers, nor combined heating surface are these locomotives the largest which have been built. The cylinder tractive force of 93,300 lb., however, has not been exceeded, and their boiler pressure of 310 lb. is the largest which has yet been employed in locomotives of this type with staybolt type fireboxes. The principal dimensions of these locomotives are compared in the accompanying table with the two largest locomotives of this type.

The Boiler

The boilers on these locomotives are 92 in. outside diameter at the first course; the second course is tapered, and the third course, which is straight, has an outside diameter of 102 in. The thickness of the nickel-steel shell in the three courses is 1 in., 1-3/32 in. and 1⅛ in., respectively.

The Kansas City Southern Locomotive Compared with the Two Largest Locomotives of the 2-10-4 Type

Road	C. & O.	A. T. & S. F.	K. C. S.
Road No.	3002	5000	900
Builder	Lima	Baldwin	Lima
Date built	1930	1931	1937
Tractive force, eng., lb.	91,584	93,000	93,300
Tractive force, booster, lb.	15,000	.....	.....
Weight engine, lb.	566,000	502,600	514,000
Weight on drivers, lb.	373,000	348,200	353,000
Cylinders, diam. and stroke, in.	29x34	30x34	27x34
Driving wheels, diam., in.	69	69	70
Steam pressure, lb.	260	300	310
Grate area, sq. ft.	121.7	121.5	107
Heating surface firebox, sq. ft.	645	592	500
Heating surface total evap., sq. ft.	6,635	6,143	5,154
Superheat. surface, sq. ft.	3,030	2,550	2,075
Comb. evap. and superheat., sq. ft.	9,665	8,693	7,229

The firebox is provided with a combustion chamber which extends forward into the boiler 75 in. The distance from the top of the crown sheet at the front and the inside of the wrapper sheet is 29-31/32 in., thus providing more than usual steam space over the firebox.

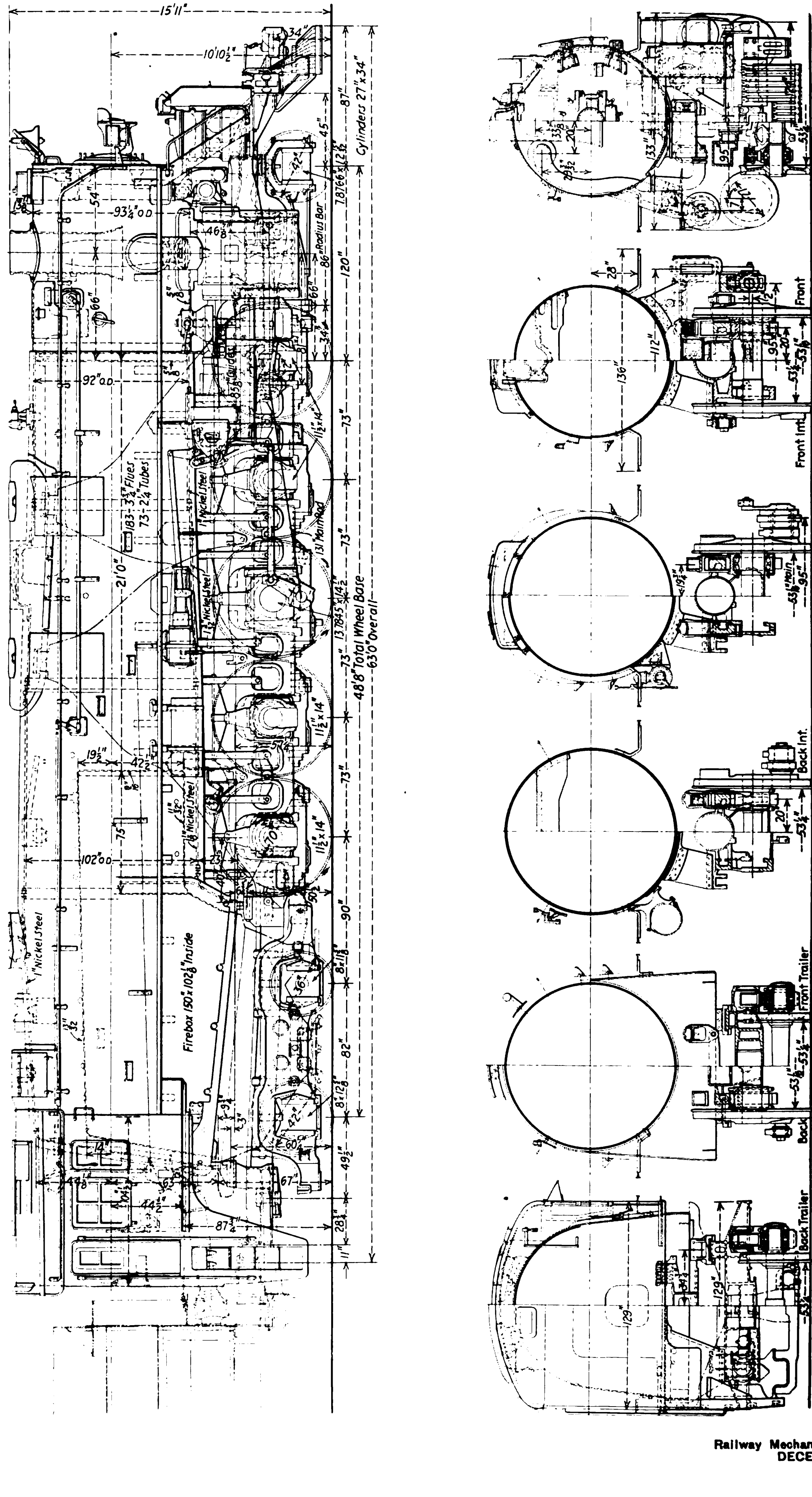
The side sheets, crown sheet, combustion chamber and inside throat sheet are welded. The inside door sheet and the tube sheet are riveted in place. The calking edge of the former, however, is welded up 36 in. from the mud ring and all inside and outside firebox sheets are welded at the calking edges around the mud ring. Calking edges of all seams adjacent to flexible staybolt sleeves are also welded. In the construction of the shell the longitudinal seam of the first course is seal welded 12 in. at the back and 15 in. at the front.

The combustion chamber is fitted with a complete installation of flexible staybolts as are also at the top, ends and upper corners of the side sheets. The coal-burning locomotives are equipped with Standard BK stokers and Firebar grates. They are fitted with ash pans of unusually large capacity.

The boilers include the Type E superheater, the units of which are installed in No. 10 BWG tubes of 3¾ in. outside diameter—one of the first, if not the first, installation of tubes of this size. The superheater header includes the American multiple type throttle valve with a maximum lift of 1¾ in. The drypipe is fitted with a Tangential steam dryer.

All of the locomotives are fitted with the Worthington Type 6 feedwater heater. The heater is mounted in the top of the smokebox and the exhaust pipe from the cylinder to the feedwater heater is attached directly to the cylinder inside the smokebox. The hot-water feed pump is located ahead of the cylinder saddle under the smokebox and is rigidly mounted on the bed casting. The hot-water line is designed to have a direct head of water from the heater to the pump. Where it emerges from the smokebox a single elbow casting connects it with the pump.

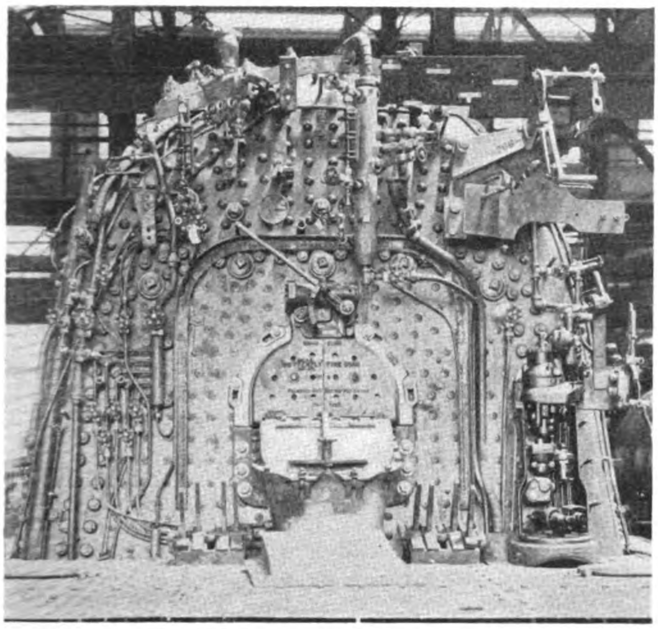
The water is delivered to the boiler through a top check. Under the check are baffle plates which break up the entering stream of water. Back of the check is a



Elevation and cross-sections of the Kansas City Southern 2-10-4 type locomotive

transverse swash plate and just in front of the back tube sheet is another. The boiler is equipped with the Model C Gunderson process apparatus for boiler-water treatment.

The smokebox on the oil-burning locomotives is based on the railroad's standard type of exhaust nozzle with



Back head of one of the coal-burning locomotives, showing the arrangement of piping under the jacket

Venturi gas nozzle. No netting or deflector plates are used.

The foundation of the locomotive is a General Steel Castings bed casting, of which the cylinders and back cylinder heads are an integral part. This casting also includes the main reservoir. The front bumper, however, is cast separately. There are four waist sheets, all of which have sliding fits on the boiler.

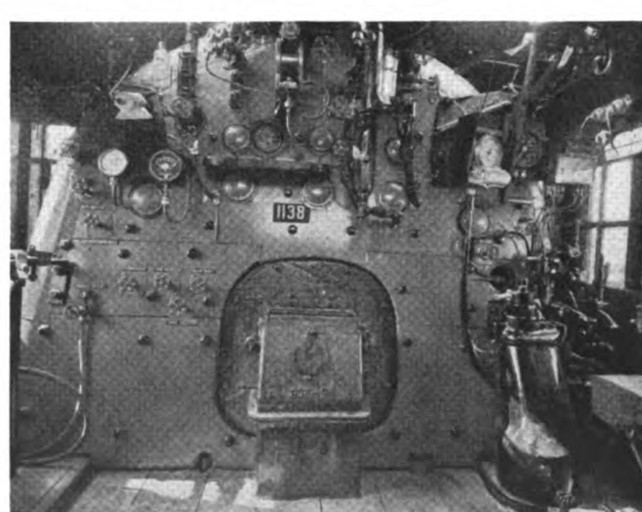
General Dimensions, Weights and Proportions of the K.C.S. 2-10-4 Type Locomotives

	Coal-burn.	Oil-burn.
Railroad	K. C. S.	K. C. S.
Builder	Lima	Lima
Type of locomotive	2-10-4	2-10-4
Road class	J	J
Road numbers	905-909	900-904
Date built	1937	1937
Service	Freight	Freight
Dimensions:		
Height to top of stack, ft. and in.	16-0	16-0
Height to center of boiler, ft. and in.	10-10½	10-10½
Width overall, ft. and in.	11-4	11-4
Length overall, ft. and in.	111-4⅛	111-4⅛
Cylinder centers, in.	95	95
Weights in working order, lb.:		
On drivers	353,300	350,000
On front truck	51,500	50,600
On trailing truck	109,200	108,400
Total engine	514,000	509,000
Tender	359,690	348,000
Wheel bases, ft. and in.:		
Driving	24-4	24-4
Rigid	6-1	6-1
Engine, total	48-8	48-8
Engine and tender, total	98-5	98-5
Wheels, diameter outside tires, in.		
Driving	70	70
Front truck	42	42
Trailing truck	42	42
Engine:		
Cylinders, number, diameter, stroke, in.	2-27 x 34	2-27 x 34
Valve gear, type	Walschaert	Walschaert
Valves, piston type, size, in.	14	14
Maximum travel, in.	7½	7½
Steam lap, in.	1 5/16	1 5/16
Exhaust clearance, in.	⅛	⅛
Lead, in.	¼	¼
Cut-off in full gear, per cent	85	85
Boiler:		
Type	Conical	Conical
Steam pressure, lb. per sq. in.	310	310
Diameter, first ring, inside, in.	90	90
Diameter, largest, outside, in.	102	102
Firebox, length, in.	150	150
Firebox, width, in.	102⅛	102⅛
Height mud ring to crown sheet, back, in.	72½	72½
Combustion chamber length, in.	75	75
Arch tubes, number and diam., in.	5-3½	5-3½
Tubes, number and diam., in.	73-2¼	73-2¼
Flues, number and diam., in.	183-3¾	183-3¾
Length over tube sheets, ft. and in.	21-0	21-0
Fuel	Soft coal	Oil
Stoker	Standard BK	....
Grate type	Firebar	....
Grate area, sq. ft.	107	107
Heating surfaces, sq. ft.:		
Firebox and comb. chamber	446	446
Arch tubes	54	54
Firebox, total	500	500
Tubes and flues	4,654	4,654
Evaporative, total	5,154	5,154
Superheating	2,075	2,075
Comb. evap. and superheat.	7,229	7,229
Feedwater heater, type	Worthington	Worthington
Tender:		
Type	Rectangular	Rectangular
Water capacity, U. S. gal.	20,700	21,000
Fuel capacity	25 tons	4,500 gal.
Trucks	6-wheel	6-wheel
Journals, diam. in.	6½	6½
General data, estimated:		
Rated tractive force, engine, 85 per cent, lb.	93,300	93,300
Weight proportions:		
Weight on drivers ÷ weight, engine, per cent	68.8	68.8
Weight on drivers ÷ tractive force	3.79	3.75
Weight of engine ÷ comb. heat. surface.	71.2	70.5
Boiler proportions:		
Firebox heat. surface, per cent comb. heat. surface	6.9	6.9
Tube-flue heat. surface, per cent comb. heat. surface	64.5	64.5
Superheat. surface, per cent comb. heat. surface	28.6	28.6
Firebox heat. surface ÷ grate area	4.6	4.6
Tube-flue heat. surface ÷ grate area	43.5	43.5
Superheat. surface ÷ grate area	19.4	19.4
Comb. heat. surface ÷ grate area	67.5	67.5
Tractive force ÷ grate area	871	871
Tractive force ÷ comb. heat. surface	12.9	12.9
Tractive force x diam. drivers ÷ comb. heat. surface	903.4	903.4

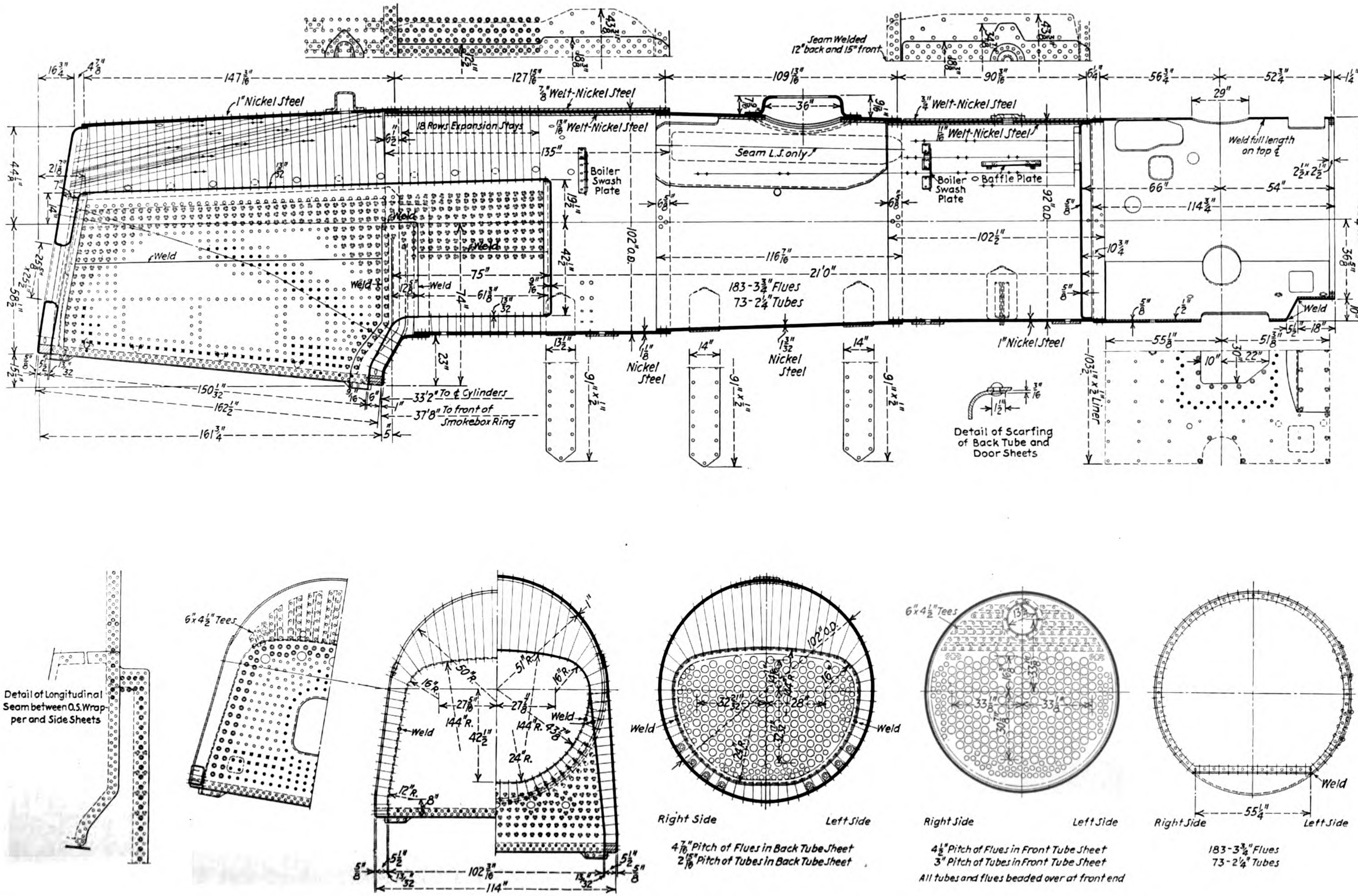
The cylinders are 27-in. by 34-in. and are fitted with three-step bushings of Hunt-Spiller gun iron. The same material is used in the valve bushings. The steel pistons and the valves are both fitted with Hunt-Spiller gun-iron bull rings and Duplex sectional packing rings.

The driving wheels are 70 in. in diameter and are of the Boxpok type. The main journal bearings are fitted with SKF roller-bearing boxes, with journals 13.7845 in. in diameter by 14½ in. long. All other journals have crown bearings 11½ in. in diameter by 14 in. long. The first, second and fifth pairs of driving wheels are fitted with lateral-motion driving boxes.

The two-wheel engine truck is of the inside-bearing type and the four-wheel trailer truck is of the Delta type, both furnished by the General Steel Castings Corporation. The engine-truck journals are fitted with



The finished back head of one of the oil-burning locomotives



Elevation and cross-sections of the boiler of the K. C. S. 2-10-4 type freight locomotive

SKF roller-bearing journal boxes. While the trailer-truck journals now have plain bearings, the trucks are designed with a view to the future application of roller-bearing boxes.

The guides and crossheads are of the multiple-bearing type. The locomotives are fitted with the Tandem type of main rod driving on the third and fourth pairs of wheels. The cylinder centers have a spread of 95 in.

Equalization is broken between the third and fourth pairs of drivers. The first three pairs are cross-equalized with the two-wheel engine truck and the fourth and fifth pairs separately equalized on each side with the trailing truck. The spring hangers are of the stirrup type.

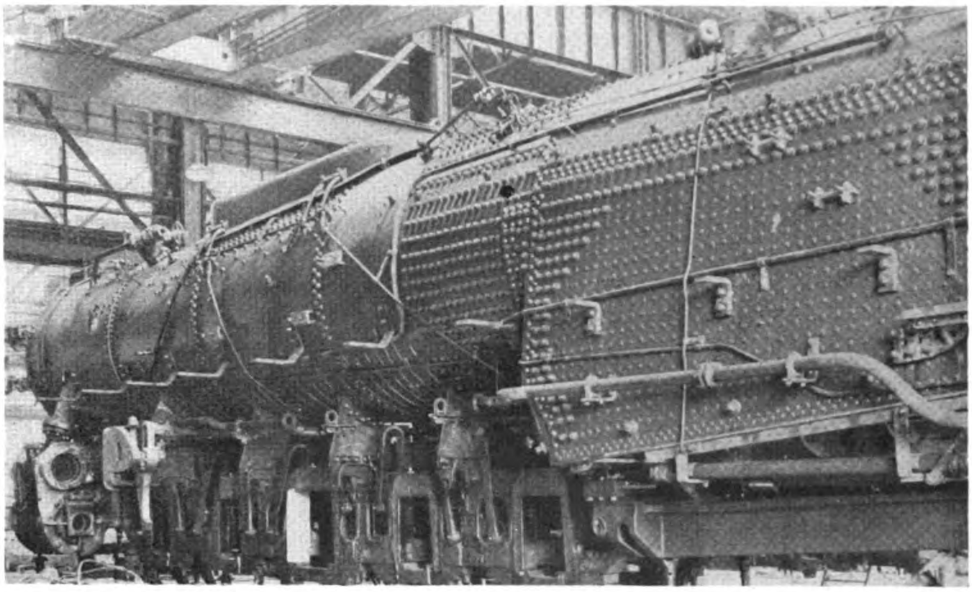
The locomotives are fitted with the Walschaert valve motion with a link of skeleton type construction. The maximum travel of the valve is 7¼ in. Franklin type B reverse gears are used.

Force-feed lubrication is provided for all driving-box hub faces, shoes and wedges, in addition to the usual feeds for cylinders, valves and guides. Detroit force-feed lubricators are fitted. Individual mechanical lubricators are provided for each air compressor.

The brakes are Westinghouse Schedule 8-ET and include two 8½-in. cross-compound air compressors which are mounted in front of the smokebox on the engine bed. The driver brakes on this locomotive are operated by five 12-in. by 10-in. cylinders. Two driver-brake cylinders, placed side by side on the guide yoke, operate the brakes on the first and second pairs of drivers and there is a separate brake cylinder for each of the third, fourth and fifth pairs of driving wheels.

Although no special cowling has been employed on these locomotives, they present an exceptionally neat appearance. Not only does this apply to the exterior of the locomotives, but also to the back heads within the cab as well. Here the arrangement of the piping under the jacket and the employment of a pedestal type brake valve conceals the usual confusion of piping in the locomotive cab. There are two sand boxes, one in front of and the other at the rear of the steam dome. They are combined with the steam-dome casing in a single structure. The locomotives are fitted with vestibule cabs.

The tenders have been built as large as possible within the limits of maximum axle loads for six-wheel trucks. The coal-burning tenders have a capacity of 20,700 gallons of water and 25 tons of coal and weigh, loaded, 348,000 lb. They are built up of Cor-Ten steel on the General Steel Castings water-bottom type underframe. The tenders are carried on Buckeye trucks which are fitted with SKF roller-bearing journal boxes. The trucks are fitted with Simplex unit-cylinder clasp brakes.



A locomotive in the erecting shop before the application of lagging to the boiler

The general dimensions, weights and proportions of these locomotives are given in the table.

Partial List of Materials and Equipment on the Kansas City Southern 2-10-4 Type Locomotives

Boiler shell and wrapper sheet, nickel steel	Lukens Steel Co., Coatesville, Pa.
Lagging, 85 per cent sectional magnesia	Johns-Manville Sales Corp., New York
Flexible staybolts (Lewis special staybolt iron)	Joseph T. Ryerson & Son, Inc., Chicago
Tubes and flues	National Tube Co., Pittsburgh, Pa.
Arch-tube and washout plugs	Huron Mfg. Co., Detroit, Mich.
Firebox	Lukens Steel Co., Coatesville, Pa.
Fire door, Butterfly No. 8	Franklin Railway Supply Co., Inc., New York
Fire brick	Economy Arch Co., St. Louis, Mo.
Grate bars (on coal-burning locomotives)	Waugh Equipment Co., New York
Stoker, Standard type BK (on coal-burning locomotives)	Standard Stoker Co., Inc., New York
Smokebox blower fittings	Barco Manufacturing Co., Chicago
Front-end hinges	Okadee Company, Chicago
Superheater and Tangential dryer, Type E	Superheater Company, The, New York
Feedwater heater, Type 6-SA-100000	Worthington Pump and Machinery Corporation, Harrison, N. J.
Feedwater hose	Gustin-Bacon Mfg. Co., Kansas City, Mo.
Low-water alarm, Type B-3	Nathan Manufacturing Co., New York
Pipe fittings	Crane Co., Chicago
Bed casting and bumper (not integral with bed castings)	General Steel Castings Corp., Eddystone, Pa.
Engine truck	General Steel Castings Corp., Eddystone, Pa.
Engine-truck roller bearings	SKF Industries, Philadelphia, Pa.
Driving-box bearings, Arctic bronze	National Bearing Metals Corp., St. Louis, Mo.
Main driving-box roller bearings	SKF Industries, Philadelphia, Pa.
Trailer truck, Delta	General Steel Castings Corp., Eddystone, Pa.
Coupler and pocket, A. A. R. Type E	Buckeye Steel Castings Co., Columbus, Ohio
Shoes and wedges, phosphor bronze	National Bearing Metals Corp., St. Louis, Mo.
Wheels, engine truck and front trailing truck, rolled steel	Edgewater Steel Co., Pittsburgh, Pa.
Wheels, trailing truck, rear, Boxpok centers	General Steel Castings Corp., Eddystone, Pa.
Driving wheels, Boxpok type	General Steel Castings Corp., Eddystone, Pa.
Tires	American Locomotive Co., Railway Steel Spring Div., New York
Springs	American Locomotive Co., Railway Steel Spring Div., New York

(Continued on page 570)

Inspection and Safety*

By John M. Hall†

Inspections which disclose condition of equipment of paramount importance in assuring safety and reliability of operation in service

We are all concerned in some manner with dependable locomotive performance, likewise we are all anxious to have safe performance. If the locomotives on any railroad in competitive territory (and where is the railroad that does not have competition?) fall short of the best possible performance, your rivals in the transportation field, be it railroads, trucks, busses, or airplanes, will surely get some of the business that your road would otherwise have retained. We are all too familiar with the results of loss of business; it affects everybody, all the way down the line.

The improvements made in recent years in average train speed, increased tonnage, and reduced fuel consumption per unit of work performed were contributed to by many factors, but the most essential element in these accomplishments is the locomotive. The value of a railroad as an efficient medium of transportation is dependent upon the fitness of its locomotives, and it is no doubt evident to all that these operating achievements could not have been accomplished if the locomotives had not been in generally good condition, however, speaking of the railroads as a whole, there is still room for much improvement in this direction. Even though the roadway, bridges, track, signals, terminals, stations, and all other facilities may be first class in all respects, and those in charge of operation highly skilled in that science, the maximum results cannot be attained if all locomotives in use are not maintained in a high state of serviceability. Safety, speed, long locomotive runs, maintenance of schedule, increase in train load, fuel conservation, are impossible of attainment if locomotives are not efficient and dependable. Rightly directed efforts to improve the present condition will be rewarded by new records of achievement in fast, safe, dependable, and economical transportation.

Problems of Mechanical Forces

Too often in attempts to get trains moving pressure is brought to bear on the mechanical forces to furnish locomotives that are not in condition to complete the trip safely and expeditiously. This situation was largely responsible for the enactment of the Federal locomotive inspection law. The framers of the law recognized that poorly maintained locomotives are a menace to safety.

If a locomotive is despatched in inefficient or unsafe condition we are taking an unjustifiable chance on an engine failure which may possibly result in an accident involving personal injury or death. When a locomotive is despatched with same weakness existing the least that may be expected is an engine failure and the effects of an engine failure are often far reaching. Failure to maintain the schedule of the train directly concerned is frequently the least important feature. Often the orderly movement of trains over a whole division is disrupted, the disruption sometimes extending to other divisions and connections. The total cost is indeterminate because it is not possible to evaluate the effect on the passenger or shipper who is inconvenienced and whose disappointment may react on the railroad.

The probable additional result of an engine failure is serious personal injury or death for one or more persons. It is the prevention of these occurrences that the locomotive inspection law endeavors to accomplish. Our inspectors still find defects on locomotives that have existed for some considerable time without any apparent notice having been taken of them by the railroad companys' employees and officers, and also defects that have been repeatedly reported by the companys' employees, and thereby brought to the attention of the proper officers, but which have not been repaired, or which show indications of ineffective attempts to make repairs.

Responsibility

The locomotive inspection law and rules are specific in placing responsibility upon the railroad company for safe construction, the making of inspections, and maintaining locomotives in proper condition and safe to operate without unnecessary peril to life or limb, yet it is not uncommon to be asked by a responsible representative of a railroad company for acquiescence in the use on locomotives on his railroad of practices long recognized as unsafe, and which if applied to a car received in interchange, would not be accepted for movement over his line.

Another procedure that is sometimes followed is to apply parts or appurtenances, or make repairs, in a manner that cannot be justified from the standpoint of safety, and then, after placing in service, attempting to obtain rulings or interpretations that will permit use ostensibly within the legal requirements. Such attempts are usually accompanied by the pretext that it would be expensive to remove the locomotives from service and make proper changes, that the parts or appurtenances, or method of repairs, are less costly than recognized conventional standards, and by the suggestion, if not argument, that the changes are "modern," when, in fact, similar, if not identical arrangements have long since proved themselves to be unsafe. We are not believers in the axiom that "there is nothing new under the sun" but it would seem that there is considerable truth in this old saying as such practices are indulged in not only by those who may have little knowledge of the ruggedness and dependability necessary to insure safety in railroad equipment and who probably are not familiar with what has heretofore been tried and discarded, but also by others who should be in a position to realize that attempts to reduce the degree of safely now afforded, no matter how much they may personally gain if successful, are not in line with "modern" progress.

The desire to create something new or different, or to deviate from current recognized practices that have been developed in the laboratory of actual experience is laudable only if the outcome promises to result in eventual savings, or is more useful, or both, and without any sacrifice of safety in either case.

* Abstract of an address before the New England Railroad Club, Boston, Mass., November 9, 1937.

† Chief inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission.

It might be emphasized that the purpose of the Locomotive Inspection Act as expressed in the title is to "promote the safety of employees and travelers upon railroads." Therefore, it is the intent of the law that the standards of safety be continually improved, rather than that concessions may be made to permit operation of equipment or use of devices or processes of doubtful safety merely because it might be thought by some that we should go "modern" irrespective of the effect it may have on the casualty list.

Every generation has its own interpretation of "modern." While modern human beings are considerably more open-minded and tolerant than their predecessors I am not sold on the idea that the current interpretation gives us license to cut corners on matters of safety without giving due weight to the fact that taking a chance is keeping open house for death. The attitude of the Bureau of Locomotive Inspection is not ultra conservative; however, our responsibilities in seeing that the purpose of the law and rules is accomplished are too great to permit us to acquiesce in, or condone, the use of equipment that would reduce the degree of safety now afforded.

The duties imposed upon the carriers by the law are absolute and continuing. The fact that a Federal inspector has not taken exception to a condition, method of repair, or method of inspection, does not relieve the carrier from the responsibility placed upon it.

Changes in Equipment and Practices

There will be, and of course should be, changes in equipment and repair practices as the state of the art progresses. These changes have gone on for ages, sometimes slowly, at other times with great rapidity though frequently accompanied by costly errors due to overlooking the importance of fundamentals. Today is a time of rapid change in the railroad world, as well as in other lines of activity, but we will advance only to the extent that we keep our feet on the ground and select that which, in the light of past experience and current available knowledge, promises to be useful and safe. It is far more important that all parts of a locomotive function reliably than it is that they be constructed in accordance with the latest theory.

Inspections and Repairs

It is the purpose of the inspections required by the locomotive inspection law and rules to detect weaknesses that may have been unintentionally or thoughtlessly incorporated in construction or when making repairs, and to disclose deterioration that inevitably develops in service. It is the first duty of our inspectors to see that the carriers make the specified inspections in accordance with the rules and regulations and that the carriers repair the defects disclosed before the locomotives are again put into service. It is therefore necessary that vigilance be exercised to discover all defects and all conditions that indicate a defect is in the process of development, and if this procedure is carried out conscientiously and thoroughly, and proper repairs made at the proper time, we will have practically eliminated engine failures which are a waste of money, and their accompanying personal injuries which are a waste of human resources. If engine failures or train delays must be had the proper place to have them is at the terminal where safe and economical repairs can be made.

The words "economical repairs" are not here used in the sense of cheapness—there is no actual exemption from admission charges to the realm of dependable performance and service; however, there is a rebate on these charges that is recovered as time goes on. Economical repairs are substantial and consequently cost more money at the time they are applied than the inferior work that always accompanies cheapness. The difference resolves itself into the fact that economical repairs are in the long run low cost repairs because they are lasting and pay a dividend in the shape of superior all around performance, while cheap and consequently inferior repairs result in consistently poor performance and are a continual source of expense and danger.

As an example I might cite an illustration of inferior repairs that caused the loss of one life and resulted in much greater cost than would have been incurred had a thorough job been done either after the defective condition was first reported or after it became manifest that the repair measures employed were not effective:

> "The left bottom crosshead shoe lost out on account of loosely fitted bolts breaking. A piece of the wreckage was thrown backward and struck the fireman causing injuries from which he died a few hours later. Reports of the condition of the bolts were made at the ends of each of seven trips prior to the accident and the repairs made consisted only of tightening the nuts on the bolts."

The loose condition of the bolts had been known for some time and this should have been construed as a danger sign by those responsible for the maintenance of the locomotive.

Protective Devices

Because of the skill developed by those whose duty it is to make the inspections most of the weaknesses and deteriorations of parts of locomotives can be found by thorough examinations but unfortunately there are occasional instances where impending failure seemingly defies detection. It is here that protective devices, or constructions that minimize damage and personal injuries, prove their value. Water glass shields that prevent the shattered glass from flying in the event of breakage of tubular water glasses represent one such device. Another is the mechanically operated fire door.

A comparatively recent accident caused by the failure of a front end steam pipe on a prominent railroad furnishes a typical example of what is accomplished in the saving of lives and reduction of injuries to a minimum by the presence of protective devices. This accident occurred while the locomotive was pulling a passenger train at a speed of about 45 m.p.h. A piece broke out of a front end steam pipe leaving a hole in the pipe approximately 4 inches wide and 21½ inches long through which steam escaped into the smoke box and thence back through the flues into the firebox. At the instant of failure of the steam pipe the fireman had just stepped on the fire door operating pedal and was looking into the firebox. He was forced backward against the coal gate, then attempted to get to the left gangway, and finally succeeded in getting over the top of the coal gate and into the coal pit. His injuries, though painful, were not of a permanent nature.

The engineman closed the throttle and applied the brake and sanders as quickly as possible, then opened the front cab window and put his head outside to escape the effects of the gas and heat. When the train stopped he found practically the entire interior of the cab to be on fire. The engineer was not injured to the extent of causing him to lose any time.

The volume of steam that escapes back through the flues and into the firebox in instances of this kind, causing a blast in the reverse direction to normal, acts like a giant blow torch discharging through the fire door if open, and pours into the cab a mixture of hot gas, burning coals, and steam. If this blast is not instantly shut

off, as occurred in this case by the removal of the fireman's foot from the operating pedal and the automatic closing of the fire door, there is little if any chance for those in the cab to escape fatal injury or instant death. The further liability is always present of the engineer being prevented from closing the throttle and applying the brake and the train continuing uncontrolled and colliding with another train or being wrecked from other causes.

I have spoken of the mechanically operated fire door as a protective device but it was originally conceived and applied as an economy device—to enable a more efficient job of firing to be done—to save coal. Thus this comparatively simple device serves a dual purpose—safety and economy. It is only one of a number of devices or constructions used on locomotives, either primarily applied for safety, or primarily applied for economy, that result in safer and more economical operation.

A water glass on the left side or back head of the boiler, in addition to the water glass attached to a water column on the right side, is another device that serves the double purpose of safety and economy. Its presence enables the fireman to readily see the water level at all times from his usual position which is a distinct aid in an efficient job of firing. A further, and more important purpose is the additional assurance provided that incorrect water level indications make themselves manifest by difference in the levels in the two glasses thus enabling prompt steps to be taken to protect the boiler against the effects of low water. A recent disastrous explosion, in which three persons were killed, might have been prevented by the presence of a second water glass on the left side of the boiler. This explosion occurred shortly after the train had left a water tank stop at which the tender cistern was filled and an informal report made to the despatcher that poor time had been made to that point due to the feedwater pump not properly supplying the boiler. After the explosion the top cock of the water glass that was mounted on the water column was found closed which indicated that the cock had been closed, probably at or before reaching the water tank, in an attempt to raise the water in the glass, and probably in the hurry to get the train moving and avoid delay the fact that the cock was closed was forgotten. If this boiler had been equipped with an independent water glass on the left side the condition of the right water glass would no doubt have been discovered in time to prevent the accident.

Safety Glass in Cabs

Another opportunity to increase the safety of operation of locomotives has been largely overlooked by the railroads. I refer to the use of safety glass in the front cab doors and windows and in cab storm windows. Practically all regulatory authorities having to do with motor vehicles require the use of safety glass, especially in the windshields, and the reasons that underlie this requirement apply equally to front cab doors and windows and to cab storm windows on locomotives. Safety glass is now used throughout in a small number of locomotives propelled by power other than steam and in some few other instances it is used in the front cab doors and windows and in cab storm windows, but ordinary glass is used throughout on the vast majority of locomotives, both steam and those propelled by other forms of power. The use of ordinary glass in the front windows and in storm windows constitutes an unnecessary hazard to enginemen and others who may be riding in the cab as is evidenced by an increasing number of injuries caused by the breaking and shattering of glass from these windows.

Firm Grip and Safe Foothold

Published statistics covering the year 1935 show that falls of persons in train service accidents resulted in the death of 27 percent of all employees killed and 30 percent of all employees injured in train service accidents. In addition 25 employees were killed and 1,762 were injured in falls of persons in non-train accidents, which was 18 percent of all employees killed or injured in non-train accidents.

Falls when in the performance of duties while working on locomotives also constitute a prolific source of injuries. In the last fiscal year there was reported to the Bureau a total of 87 accidents in which 4 employees were killed and 83 employees injured from this cause. None of these falls could be attributed to any features encountered in connection with the condition of locomotives, it being apparent in each instance that the falls were caused by inattention or sudden illness on the part of those killed and injured. These accidents do not come within the scope of the locomotive inspection law but are mentioned here in order to emphasize the necessity of a firm grip and safe foothold and alertness on the part of all concerned.

Reporting of Accidents

The rules provide that in the case of an accident resulting from failure, from any cause, of a locomotive, its boiler, or tender, or any appurtenances thereof, resulting in serious injury or death to one or more persons, the carrier owning or operating such locomotive shall immediately transmit by wire to the chief inspector a report of such accident. A further provision is that when the locomotive is disabled to the extent that it can not be run by its own power, the part or parts affected shall be preserved intact, so far as possible without hindrance or interference to traffic, until after our inspection.

The channels set up by some of the carriers through which reports of accidents are supposed to be made to the chief inspector are so circuitous that reports are often unduly delayed, in some instances the parts affected are not preserved intact, and sometimes no reports are made. Without expressing any opinion as to the purpose, if any, of failing to make the reports in the manner provided it might be said that such procedure tends to defeat the purpose of the law as it prevents the conducting of as thorough investigations as could otherwise be made. Inasmuch as accidents coming within the scope of the locomotive inspection law originate on equipment for which the motive power department is accountable it would appear that responsibility for properly reporting these accidents should be placed upon that department.

Reduction of Accidents and Casualties

In the fiscal year ended June 30, 1937, the number of inspections of steam locomotives made by our inspectors was 100,033; the number of locomotives found defective was 12,402, or 12 percent of the number inspected; a total of 49,746 defects were found; and 934 locomotives were ordered out of service because of the presence of defects that rendered the locomotives immediately unsafe.

In 1937 increases occurred in the number of accidents, the number of persons killed, and the number of persons injured as compared with the year 1936; these increases were due to a greater volume of traffic handled by the railroads and to two particularly violent boiler explosions in one of which four persons were killed and in the other three persons were killed. Considering the circumstances, this is a very creditable showing, particularly if a comparison is made with the year 1923. The results for 1937 compared with 1923 show a decrease in acci-

dents of 80 per cent, a decrease of 65 per cent in the number of persons killed, and a decrease of 82 per cent in the number of persons injured.

The accidents and casualities that occurred in connection with failures of boilers and boiler appurtenances in the fiscal year ended June 30, 1937, compared with the year 1912, the first year the boiler inspection act became effective, are shown in the table. The original act applied to boilers and their appurtenances only and the table shows the relative improvement in safety of these parts.

Safety and economy are inseparable twins; if locomotives are maintained in the safest possible condition the maximum in efficient and economical operation will be attained. The interests of the Bureau of Locomotive Inspection and of the railroads are mutual in this respect because the ends sought by each are similar and can be attained only through exactly the same means—thorough inspections and timely and proper repairs.

Accidents and Casualties Caused by Failure of Some Part or Appurtenance of the Steam Locomotive Boiler

	Fiscal year ended June 30— 1937	1912
Number of accidents	63	856
Percent decrease	92.6	
Number of persons killed	19	91
Percent decrease	79.1	
Number of persons injured	73	1,005
Percent decrease	92.7	

Calculations Versus the Feel of the Thing in

Diesel Engine Development

Charles F. Kettering, vice-president and general manager of the General Motors Corporation, has the faculty of discussing difficult and complicated engineering questions and scientific problems in a simple, understandable and most interesting way; indeed he is today regarded as one of the most popular, if not the most popular, speakers in the engineering and scientific world.

In discussing extemporaneously the possibilities of the Diesel engine in railway service at a luncheon given by Alfred P. Sloan, Jr., chairman of the General Motors Corporation, to a group of railway officers and industrial leaders in New York on October 28, he made the following observations:

Another question is asked, "What is the future of this type of power development?" I haven't the slightest idea. We have been making an enormous number of automobile engines for years. We have built, up to the present time, about 40 millions such engines and we are still improving them every year. In terms of horsepower we are just starting on the Diesel engine. Last year, for instance, if we take four million automobiles as the baseline and conservatively estimate them, below the advertising man's wishes, at 50 hp. each, we made 250 millions of horsepower. I think that we made about two millions of horsepower of Diesel engines. So we are making one per cent of the horsepower today in Diesels that we make in gasoline engines. That leaves the whole future ahead of us and as we improve these things and get them better, they are going to fit into their adjusted places as the demands require.

Microscopic Tolerances

So you can look ahead with a great deal of interest to the future development of this type of power. It is always going to cost a little more than the gasoline engine, because the injectors are expensive to make. So far as I know they are about the most accurately made pieces of apparatus known. The limits on the pump for the very high-pressures at which they must operate are very small indeed. As we say in the shop, "Our limits are a quarter of a tenth of a thousandth of an inch." Let me give you that in terms which are a little bit different. You have all seen a log on a sawmill; if you took a three-foot log and sawed it up into inch boards, you will get 36 one-inch boards, less the sawdust. Now imagine you took a human hair and sawed it up into 120 parts, each part would be a quarter of a tenth of a thousandth of an inch.

We have to make our injector plungers fit that close because if we didn't, the oil would leak by the plungers when the pressure was applied and it would not get into the cylinders. No manufacturing fellow likes to make fits that close. But we just say, "that's right, make it the way you think it ought to be, and then it won't work." So you have to accept that. The interesting thing about it is, that after they are made to that high degree of accuracy they apparently don't wear very much. This is one of the puzzles we don't understand.

A Lot We Don't Know

Two of the troubles that bothered injectors ended in an entirely different manner from predictions. Plungers do not wear and the fine holes through which the oil is forced do not erode or wear out. All of which is another way of saying that there is a lot we don't know.

We are very likely to sit down at a calculating table, make some figures, and abide by them before the experiment—but we still have to experiment.

I am going to tell you a very interesting story about calculations. Recently they were taking some very beautiful motion pictures of a cat—a fellow held the cat upside down, and let him loose. He turned over and landed on his feet. We have known for a long time that cats do this. Now, a man in Cambridge University in England studied each motion of the cat and wrote the differential equations for it. When, to his very great surprise, he found that they checked perfectly, he said that that was the reason why the cat landed on its feet. But if the cat had stopped to figure out those equations as he turned over, he would have landed on his head.

The Feel of the Thing

The cat has the feel of the thing and that is the reason he can turn over. For many, many years we have been trying to tell all scientific people that there is something in experience which gives you the feel of the problem. We are just getting the feel of this new type of power. The first time maybe we didn't land on our feet, but we got part way over. We do have the greatest confidence in the world that the Diesel can be developed into a most important industry—one which will be of great service to the railroads, one which will put more men to work, and one which will expand our ideas of the uses of power beyond anything of which we now know.

Spray-Type

Air-Conditioning System

The Sturtevant Company develops unit in which cooling by evaporation is substituted for refrigeration at the lower temperatures within the cooling range —An ultra-violet sterilizer provides for uniformly healthful atmosphere within the car throughout the year

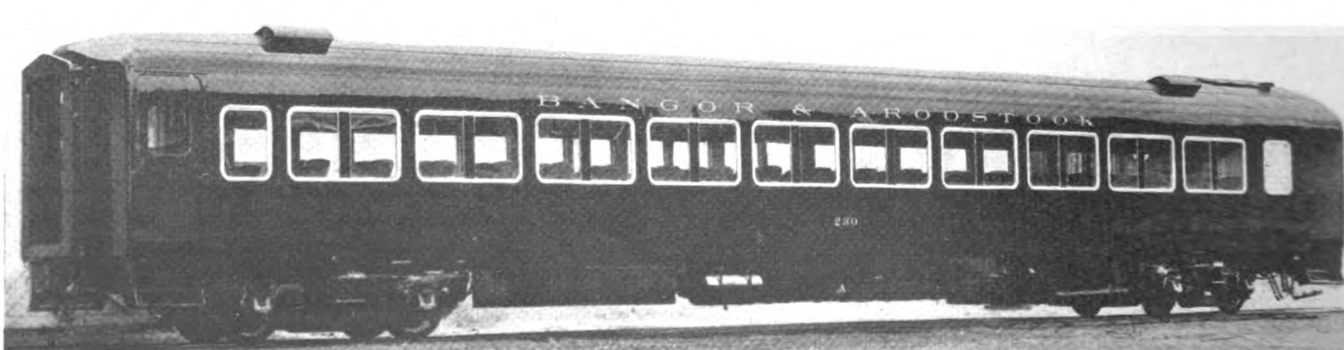
An application of the Sturtevant spray-type air-conditioning system in which has been incorporated an ultra-violet-ray sterilizer was made on the two new passenger coaches and three combination buffet coaches built by the Pullman-Standard Car Manufacturing Company for the Bangor & Aroostook during the past summer. The spray-type air-conditioning system on these cars is ice-activated but operates with evaporative cooling only when the outside wet-bulb temperature falls below a predetermined point. The ultra-violet-ray sterilizer operates during cold weather when the water spray is not in use. Combined with the sprays, which, themselves, have a sterilizing effect on the air, the ultra violet ray thus provides a year-round effect, so far as air-borne infection is concerned, equivalent to the operation of the air-conditioning system with a circulation of 100 per cent fresh outside air.

The Sturtevant air-conditioning units are overhead mounted and the ice bunkers, sumps and water-circulating pumps are mounted beneath the car body. The overhead equipment is assembled in two units. The fan and motor assembly is mounted over the vestibule, with the fresh-air grille in the vestibule ceiling. The washer unit, through which the air passes from the fans, is mounted above the ceiling near the end of the car. Each unit is completely self-contained. The washer unit is supported in a light frame of structural steel which is suspended from the car roof, thus relieving the unit itself of any distortion which might arise from direct attachment of the casing to the car structure. The unit is installed through a removable hatch in the car roof. The recirculating-air grille, which is located in the ceiling near the end of the coach, is connected by duct to the suction box of the blower unit. A central air-distributing duct down the length of the car distributes uniformly so that a gentle diffusion takes place, as it passes from the duct into the passenger compartment.

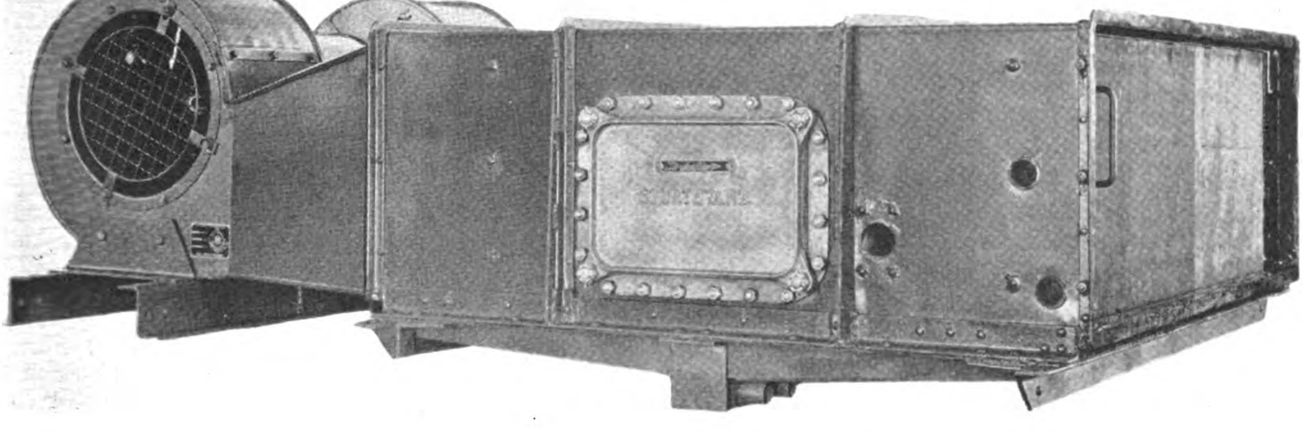
The fan and motor assembly consists of two single-width Rexvane centrifugal fan wheels, one mounted on the shaft extending from each end of the motor. The fan casings are split in order to facilitate the removal of the complete motor and fan assembly for repairs. The motor-fan unit is assembled in a suction box, with all balancing and adjusting of parts completed in the shop, and is installed in the car as a unit with wiring connections made in a single conduit box within the suction box. The motor is ¾ hp. in capacity, compound wound, and may be provided for 32, 64, or 110 volts d.c. In each case the motor is designed to permit operation with unregulated higher voltages at increased speeds. The normal operating speed of the motor is 1,200 to 1,500 r.p.m., delivering from 1,500 to 2,400 cu. ft. of air per min.

The washer casing is made of No. 16 gage galvanized steel and No. 30 oz. copper. The galvanized steel is used for the upper portion of the casing and the copper for the drain pan at the bottom. The joint between the two parts of the casing is sealed watertight with a special compound and no edges of the steel are exposed to the interior. The casing is buttressed with bands of light angle section and the bottom rests on a welded steel framework. Suitable marine access doors are provided to permit access to the interior of the casing for the removal or application of the spray nozzles. The doors fit against frames, producing watertight joints sealed with tubular rubber gaskets, and are held in place by four castle nuts each.

The copper drain pan has been designed of such proportions that no accumulation of spray water will occur in the overhead unit. A special hyperbolic streamline elbow carries the water from the spray nozzles immediately into a single return pipe leading from the bottom of the drain pan to the ice-bin sump beneath the car. Cars with insufficient headroom for a single return pipe from the drain pan may be equipped with two return



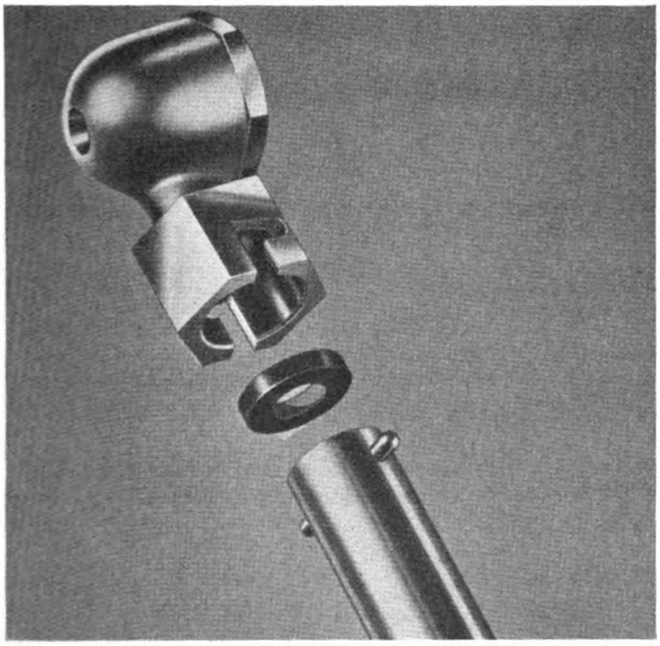
One of the Bangor & Aroostook coaches fitted with the Sturtevant spray-type air-conditioning system



The blower and spray cooling units of the Sturtevant air-conditioning system

pipes and special streamline fittings to accomplish the same result. In most cases, however, the single return pipe can be adopted and the amount of piping reduced to the same as is used with any conventional coil type air-conditioning units.

The principal feature of the air-conditioning unit is the use of spray nozzles which have replaced the usual type of cooling coils for the purpose of heat transfer. These nozzles are attached to suitable pipes branching from a single transverse water-distributing header by means of bayonet-lock joints and rubber gaskets. They are thus readily replaceable, although the smallest opening in each nozzle is $\frac{3}{16}$ in. in diameter and there is little likelihood of choking up with any material which may pass the strainer in the piping system beneath the car. They produce a deluge of highly atomized chilled water through which the circulating air passes. Air from the washer chamber is mellowed to the proper humidity, resulting in an atmosphere within the car which need not produce a sensation of shock to passengers entering it from humid, hot outside air. The omission of the main cooling coils removes a source of odor-producing accumulations, and the passage of the recirculated air through the spray tends to clear up odors originating in the car.



Detail of patented bayonet latch-type nozzle

Built permanently into the casing near the end through which the air enters is a single fin-tube precooling coil fed by a $\frac{1}{2}$-in. pipe. The use of the precooler is of advantage both in economy of ice consumption and in adequacy of evaporative cooling. At the opposite end of the casing is placed the steam-heat radiator which is a double fin-tube coil. Between the heating surface and the nozzles is a tri-hook moisture eliminator consisting of a bank of zigzag vanes, in passing through which the direction of the air is sharply changed three times. A similar eliminator is also installed at the entering end of the casing.

The controls are of the conventional type wherein the car temperature may be adjusted and automatically regulated to one of several thermostat settings to be made by the trainman. An additional selector control operated by an outdoor wet-bulb thermostat automatically changes the system from ice cooling to evaporative cooling. This control consists of a damper motor which operates to open and close a portion of the area through the outside-air intake grille and to cause the water circulation to by-pass the ice bunkers. The wet-bulb thermostat is mounted in the fan suction box. When the wet-bulb temperature drops below a predetermined point (about 64 deg.)* the damper motor opens the outside-air damper and closes off the recirculation-air duct where it enters the fan suction box, thus producing 100 per cent fresh-air circulation. The circulating water for the sprays is caused to bypass the ice and cooling is entirely by evaporation. When the outside wet-bulb temperature rises above the setting of the wet-bulb thermostat the damper motor operates to close the fresh air-intake dampers and to open the duct from the return-air grille, thus restoring the circulation to the predetermined minimum proportion of fresh air—25 per cent in the case of the Bangor & Aroostook installation—and the water again circulates through the ice bunkers.

It is well known that in sneezing thousands of micro organisms may be discharged into the air and spread throughout any confined space. It has been found that the spray removes or destroys bacteria or other micro-

* A wet-bulb temperature of 64 deg. F. may occur in normal weather conditions with dry-bulb temperatures as high as 95 deg. F., according to official weather records and tests under actual railway car service conditions.

organisms expelled into the air by the passengers so that with the maximum percentage of air recirculation the effect within the car is equivalent to the introduction of cooled and nearly sterile outside air at the rate of 2,000 cu.ft. per min.

For wintertime use, when the sprays cannot be operated without window condensation and other difficulties, an ultra violet sterilizer has been developed. This consists of lamps of pure fused quartz, emitting high-intensity ultra-violet light, which are installed within the highly reflective aluminum recirculating box just above the return-air grille. The lamps are connected to a Sturtevant Railvane rotoformer for operation on 32 volt d.c. and require a total power input of 460 watts. The high-intensity ultra-violet light produces a sterilizing effect on the recirculated air practically equivalent to that produced by the spray operation during the summer, thus providing a uniformly low percentage of air contamination within the car throughout the year. The air purification design was developed with the aid of the consulting services of W. F. Wells and M. W. Wells of the University of Pennsylvania.

The cooling water is drawn from the overhead unit in most cases through a single return pipe from the drain pan leading to a sump beneath the car. A special design of pump with duplex impellers forces this cooling water through the conventional three-way bypass valve arrangement to the ice bins or directly back to the sprays in the overhead unit. Only one pump, therefore, is required per car, although some installations have been made using two pumps with single impellers of the conventional type. The power required by the double impeller pump is only slightly more than the power of a single pump. The three-way valve and its interconnecting piping to the ice bins and ice-bin sump is identical with the arrangement of such piping on cars equipped with conventional coil-type air-conditioning units, the setting of the valve being electrically controlled from the main automatic control switchboard panel.

Since chilled water is the essential means of conditioning the air passing through the spray unit, the design lends itself to the ice-storage system of cooling. The mechanical refrigeration system is readily adapted to the spray-conditioning unit, however, by replacing the ice bins with a water chiller beneath the car. The refrigerant from the mechanical system is expanded directly into the tubes of the water chiller through an automatic expansion valve. The chiller provides a storage of cold water and, in effect becomes a holdover reservoir at station stops.

An additional water-storage reservoir or sump of approximately 50 gal. capacity is recommended to be located in the water piping line between the water chiller and the drain pan of the overhead spray-cooling unit. The reservoir serves two purposes: First, it provides a supply of water for evaporative cooling in mild and dry weather; second, it provides a reservoir of relatively quiet-flowing water in which dust collected from the air by the sprays will precipitate, forming a sludge at the bottom which can be readily cleaned out at suitable periods.

Developments in Car Design*

By W. H. Mussey †

A discussion of the use of weight-saving and corrosion-resistant materials in car construction — Results of strain-gage tests of car structures

THE whole country is becoming weight conscious and the railroads and allied industries are alive to the irresistible urge. The more dead weight you save the less the demand on the power plant that hauls the train. Take a glance at the results to be obtained from the saving of deadweight in two types of service—passenger and freight.

Passenger and Freight Service

The public demand and the railroads are speeding up train schedules. In all cases the schedule is dependent upon the ability of the power plant to do the job and that means get into the terminal on time, taking into account not only the tightness of the schedule but delays, usual and unusual, that are bound to occur.

Railroads will not reduce the number of cars hauled below passenger-space requirements and the operation of two sections where one should answer is not worthy of consideration.

There are two vital factors which combine to make up train resistance and determine the amount of work the power plant must do—wind pressure and weight. Streamlining is a very important item at extremely high speeds and on short trains, but as the length of train increases the advantage gained by streamlining decreases due to increase in skin friction. Streamlining contributes to reduction of train resistance, has eye appeal, and the public likes it. They sense that they are on a modern high-speed train.

When it comes to starting, accelerations after slow-downs and mounting grades, it is reduction in weight, not streamlining, that counts. From our own knowledge most high-speed passenger-train schedules stand or fall due to the ability of the power plant properly to handle starting, acceleration and grades and their importance seems to progress in the order named. Saving of dead weight permits train speeds of more miles per hour.

One might ask why not increase the size and capacity of the power plant. If it were practical by so doing to meet the power requirements imposed in making high schedules with heavy trains, it would be undesirable, from an economic standpoint, for reasons that must be obvious to all. As a proof of this, the manufacturer of the power plant, whether it be a steam locomotive or an internal-combustion engine, is the staunchest advocate, of the lightweight train for high-speed service.

The freight car offers a field only casually explored as to the savings that will result from the reduction in dead-weight tonnage.

A saving of five tons in dead weight of a box car

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means approximately 54,000 ton-miles per year. If all of the 730,000 box cars in service each represented a like reduction, the saving would be 39,420,000,000 ton-miles per year. You can't laugh that off!

New Material and Tools

New materials and new tools have been introduced which present the key to the attainment of the goal—the reduction in dead weight of railroad equipment.

Let us first consider the materials which are now available and their possible, or practical, application to the problem.

The materials are low-chrome high-tensile steel, stainless steel (18-8) in the cold rolled state and high-tensile aluminum alloy (17 ST) heat treated.

We give their physical characteristics in the order named and, as a comparative yardstick, I quote, first, normal low-carbon open hearth as per A.A.R. Specification (M-116-34).

Low-Carbon Open-Hearth Steel

Plates for cold pressing	
Modulus of elasticity	28 to 30 million; average material 29 million
Yield point	24,000 to 29,000 lb. per sq. in.; actual minimum about 30,000 lb. per sq. in.
Tensile strength	48,000 to 58,000 lb. per sq. in.; actual minimum about 60,000 lb. per sq. in.
Elongation in 2 in.	Not covered by specification—minimum about 30 per cent

Low-Chrome High-Tensile Steel

U. S. Steel Specification for Cor-Ten	
Modulus of elasticity	28 to 30 million; average material 29 million
Yield point, minimum	50,000 lb. per sq. in.—average material 55,000 lb. per sq. in.
Tensile strength	60,000 to 75,000 lb. per sq. in.—average material 75,000 lb. per sq. in.
Elongation in 2 in.	23 to 28 per cent—average material indicates 28 per cent

Stainless Steel (18 Per Cent Chromium, 8 Per Cent Nickel)

U. S. Steel Specification	
Modulus of elasticity	Quoted as 28 million
The above figure applies only to the material in the annealed state. When cold rolled for essential parts of car structures actual tests indicate 21 to 23 million.	
Yield point	60,000 to 125,000 lb. per sq. in.
Cold rolled specimens indicate a yield point considerably above 125,000 lb. per sq. in.	
Tensile strength	110,000 to 175,000 lb. per sq. in.
Elongation in 2 in.	10-45 per cent
The percentage of elongation decreases in proportion to the extent of the cold rolling. Tests made of material used in car structures indicate less than 20 per cent.	

High-Tensile Heat-Treated Aluminum (17 ST)

Specification of The Aluminum Company of America	
Modulus of elasticity	10,300,000
Yield point (typical)	35,000 lb. per sq. in.
Tensile strength (typical)	58,000 lb. per sq. in.
Elongation in 2 in.	20 per cent
Tests of average samples indicate	26 per cent

We put the modulus of elasticity as the first item in each case as it is the dominating factor in the deflection formula. It has been the policy of the Pullman-Standard Car Manufacturing Company in designing all of its railway passenger equipment to keep within the requirements of the Railway Mail Service Specifications which in the past have always been the basis also of passenger-carrying cars purchased by the railways. We do not say that the new cars are stronger than the more conventional type of passenger-train equipment which has been operating on the rails during the past quarter century. We do, however, claim that the new cars built by this company are of equal strength to withstand buffing shocks with the older equipment and that they comply fully with the Railway Mail Service Specifications. If it were not for certain physical characteristics peculiar to aluminum and stainless steel of high-tensile grade, cars which are designed of these two materials could be somewhat lighter than it is possible to make them and still comply with the Railway Mail Service Specifications and the requirements of good car design.

The engineer has been accustomed to designing cars based on the stress calculations when using ordinary open-hearth steel. If this method is followed in the design of aluminum and high-tensile stainless-steel structures subject to buffing and other live loads resulting from operation in service, the car will present too much flexibility, due to the resiliency of these two materials which exhibit greater deflections in the high-tensile state than the low-chrome alloys for the same cross-sections when subjected to identical loads. For this reason it is necessary, in order to provide for the proper strength and rigidity of car structures to increase the cross-section of the load-carrying members made of aluminum or high-tensile stainless steel, subjected to compression stresses, sufficiently to keep the amount of deflection within satisfactory limits. In aluminum the cross-section can be satisfactorily increased and still have a resulting weight considerably under the weight of corresponding members built of any of the alloy steels, but the amount that must be added to the stainless-steel member increases the weight because a cubic foot of steel weighs the same whether it is of high-tensile stainless steel, or Cor-Ten.

The above outline briefly states the reason that the Pullman-Standard Car Manufacturing Company has confined its efforts to aluminum and low-chrome high-tensile alloy steel in the design and construction of its lightweight cars. As stated before, it is a question of economics. For this reason it is our belief that in the long run the majority of steel passenger cars will be built of moderately priced low-chrome alloys and that, when extremely light weight is desired, aluminum will be used.

It is a very interesting thing in considering some of the exaggerated claims of extreme weight savings over present lightweight equipment to realize that, for a Pullman sleeper car-body-framing members only, the weight has been decreased from 58,330 lb. for a conventional riveted car of low-carbon normal steel to 26,000 lb., and, for a coach, to 23,000 lb., both fully welded, and it must be evident to all that any considerable further saving cannot be obtained by reducing the car framing with the use of any type of steeel of which we have commercial knowledge. The additional saving must come by taking into account everything that goes inside or outside this car shell, as well as the trucks.

In the construction of freight cars the total cost of the car is relatively low as compared with passenger cars, and railroads, as a whole, have felt, whether they are right or wrong, that lightweight freight cars of ample strength to replace the present freight car must represent no material increase in cost. This naturally limits us, as we see it now, to low-carbon steel, with and without copper content and Cor-Ten steel, or equivalent, with its increased corrosion resistance. Two other materials—aluminum and high-tensile stainless steel—represent a cost per pound which, naturally, would add considerably to the cost of a freight car and, as we see it, would not be justified, except in special cases.

The spread in cost between normal low-carbon steel and low-chrome high-tensile steel amounts to something, of course, but, as we have clearly demonstrated, we can, commercially, in design and construction, utilize the higher yield point of this material to its fullest extent and make a larger reduction in weight. We are convinced that further considerable increase in yield point would be of small additional value and, of course, would entail an added cost considering any material commercially produced at present.

Corrosion Resistance

The cars we have designed and built have been constructed of Cor-Ten steel, or equivalent, and the results obtained have justified its use. Recent tests of the box car built by the Pullman-Standard Car Manufacturing Company which was on exhibit at Atlantic City in June have been viewed by officers of the A.A.R. and a good many railroad men covering a wide cross-section of the railroads of the country. They have demonstrated that the car is capable of standing at least as great and probably greater impact blows, both longitudinal (buffing) and vertical (live load), than the standard A.A.R. car. It must be said for the A.A.R. car, however, that it has fully met all operating requirements; the tests to which we subjected these cars are excessive and of a destructive nature.

There has been much discussion as to the corrosion resistance of various materials entering into car construction. This general term needs some explanation, or rather a statement of what corrosion really means.

There are, as we see it, two types of corrosion—one is straight atmospheric corrosion, which proper maintenance will fully take care of; the other type, which is more serious, is corrosion due to working of the sheets, localization of stresses, etc., which might be called accelerated corrosion. This is the problem. Undoubtedly, any material which has increased corrosion resistance, such as the low-chrome high-tensile steel, aluminum, except in the presence of alkalies, and stainless steel, with its high corrosion resistance properties, is a desirable thing, but to pay any considerable premium for this quality does not seem to be justified by the facts.

The Pullman Company has made various examinations of car structures built more than 25 years ago and others of less age and corrosion present as disclosed by the removal of inside finish sheets has been of a negligible character; in other words, we might say it is practically nil. That, of course, applies to passenger cars and is the result of proper design and maintenance.

Examination of many freight cars shows that what has been said of passenger cars also applies to freight cars. One very marked example of this is the five welded hopper cars which we built in 1931 for the Chicago Great Western with which you are all probably familiar. The coal that is hauled in these cars is of relatively high sulphur content and considerably more corrosive than the average coal, yet, from frequent examinations of these welded structures, which are of plain open hearth steel, we have found only a small low rate corrosion. There seems to be no doubt that the life of these cars will not be dependent upon corrosion of the essential parts of the structure. The same cannot, however, be said of riveted cars built at the same time, of the same material, and operating under the same conditions.

It is self-evident to all that have made even the most casual study of car design and car structures that the only possible way that we may reduce weight in car framing structures is to reduce the cross-sectional area or thickness of the sections, plate, bars and sheets that go to make up this structure and thereby take full advantage of the physical characteristics of the steels.

Of course, the customary riveting of car structures has proved very satisfactory in conventional car design because the heavier sections provide sufficient bearing area for the rivets. The net section left in the sheet, plates, etc., after the holes are punched in them is sufficient to develop proper strength in the car framing and it isn't necessary that the car represent, in effect, a one-piece structure, because the members are of sufficient size to stand various concentrations of stress and deflection. However, when we come to the thinner members it is necessary to obtain proper strength and weather tightness, and that means rivets, if used, which are placed very close together in the case of both superstructure and underframe. Then the net sections of a plate or sheet available to withstand severe service has been very markedly decreased. Furthermore, naturally the rivets would be of such size that they couldn't withstand the extreme concentrations produced by impact stresses.

Welded Construction

A study of welded construction convinced us that a welded structure properly designed and built would produce the strongest and lightest car.

It was further decided that the light sheets and, in fact, practically all of the superstructure would have to be spot-welded, both from a design and commercial standpoint. Arc or gas welding has the greater value in fabricating the underframe members and should be used, therefore, for the best results.

In 1935 we built a lightweight box car of Cor-Ten steel in which the underframe was partly arc welded and partly riveted. The superstructure was spot-welded. This car was built as an experimental lightweight car for the purpose of determining suitability of low-chrome high-tensile steel, or the soundness of the principles of design, the practicability of the type of welding equipment and the possibility of building such a car weighing 4½ tons less than, but at the same cost as, the A.A.R. standard car.

The box car was tested by the A.A.R. for static and live-load vertical loadings and under impact tests. After that it was put in service and has made in excess of 26,000 miles with no repairs.

Shortly after this we built an alloy-steel welded refrigerator car with outside welded-steel sheathing. The underframe was fully arc welded and the superstructure spot welded, using the same equipment for spot welding as had been used in connection with the box car.

The refrigerator car represents a saving of 10,000 to 13,000 lb. in weight over other cars of similar size and that car has made approximately 40,000 miles, with no repairs other than the usual run of maintenance items such as brake shoes, bearings, etc.

This demonstrated to us that a welded car could be built for severe service and it would give good results and be perfectly satisfactory.

Under the impact test of the lightweight box car (PLM No. 500) we had a chance to study a combination of riveting and welding on the underframe, the practicability of the spot-welding equipment available at the time this car was built and to study methods for reducing costs.

After a very careful analysis of the results obtained from impact testing and of the car in service, we thoroughly explored the field of spot-welding technique and equipment. In the first part of this year we convinced ourselves that steel freight cars could be produced at a low cost with absolutely reliable welds. The previous designs needed some modification to use the best that there was in spot welding. The same general fundamentals could be followed as practiced on the first car. The combination of riveting and arc welding on the underframe was not the equivalent of a fully welded construction. The center filler, back stop and the striking members were built up of rolled plates welded into the center sill conforming to the construction we have applied to many cars with most satisfactory results.

In April of this year we were authorized to build another welded box car of the new A.A.R. dimensions which are larger than the previous standard. The car was completed in May and was on exhibition at the A.A.R. convention in Atlantic City in June. It represented a saving of approximately five tons in deadweight over the A.A.R. box car of similar large dimensions.

In all of these cars we have used lightweight chilled-iron wheels which have represented a reduction in weight of 680 lb. per car and frequent inspection of these cars has demonstrated their serviceability.

This car has been subjected to most severe static and live load vertical loading and high-speed impact tests. The A.A.R. representatives and railroad men were present and witnessed these tests. None of the members of the car structure was distorted. Of the approximately 14,000 spot welds in the superstructure not one of them let go. In other words, we have proved that welded lightweight structures as represented by this car will assure the railroads of the ultimate in lightweight and strength, that the cars will not be on the repair track but in service, and the study of construction methods has convinced our company, and they have stated publicly, "This car can be produced without any premium in cost over the conventional riveted car."

As a further step in connection with the statement above, one of our freight-car-building plants is providing facilities and equipment has been ordered and will be installed for producing approximately 25 cars a day of this lightweight welded construction. The plans are to have this plant in operation within the first month of the coming year. The welding equipment will be largely automatic and the handling and fabrication will eliminate, as far as possible, manual handling.

Testing Car Structures

It might be of interest to give more information about the methods followed in making the tests. As we mentioned previously, after the lightweight welded box car was built it was thoroughly tested. In this series of tests we applied at approximately 125 positions on the car-body instruments which would record the stresses under both static and live load conditions, but, of course, the static condition means very little as compared with those of live load or impact.

These instruments we have known of for some few years, but we have not been able until this time to assure ourselves that we had the proper technique of the application, adjustment and determining the stresses which they recorded.

During the past summer we have been doing a lot of impact testing of car structures under extremely variable conditions and, through the aid of Professor Roy of the University of Illinois, who is at present associated with the Association of American Railroads, we reached such a point that we were positive that the results obtained were reliable that they could be used for testing car structures without any questionable reservations.

The instruments record the stresses, whether they be compression or tension, their magnitude, the number of vibrations per impact, whether the impact produces a stress beyond the yield point of the material, how much was due to bouncing of load and how much to straight impact and whether any permanent set or deformation occurred in the members upon which they were placed.

In order to make sure that our investigation was complete the 125 scratch gage instruments were applied at all critical stress points throughout the car body and other points to assure ourselves that there were no sudden changes in stresses and that the structure was acting as a whole.

The scratches or stress indications are recorded on a brass plate, chrome plated, and when removed from the tested member are placed under a microscope which has a definite magnification—about 75 diameters—and the readings of the various phenomena occurring during the impact are recorded and proper curves drawn to illustrate what has happened. A study of these readings brings out some very interesting facts. Whereas the car as tested under the observation of the A.A.R. has not shown any distortion after removal of load some of the recorded impact stresses have been in some cases beyond what we call the static yield point. For the lower speed impacts where the blow is not sharp they evidently follow very closely along the line of static stresses but as the higher impact speeds are reached there is a stress surge above the static yield point, in some few cases. Since the impact blows are applied almost instantaneously, the car structural members are subjected only momentarily to some localized stress which may exceed the static yield point, but not accompanied with a permanent set unless stresses are considerably above the yield point. This localized stress, unless excessive, even though it may have been somewhat above the static yield point, is immediately relieved after the impact, so as to produce practically no effect on the integrity of the structure and there has been no detrimental effect on the member under consideration. Undoubtedly this occurs at all times in all car structures. Or in other words, there is a vast difference between static stresses and impact stresses in their effect on the structure and the mere consideration of a static load to determine the stresses within a member or within a structure is of little value.

The recording of impact stresses, occurring as they do under certain localized conditions, permits the designer to make in most cases only a slight alteration and iron out the stresses even under this impact condition and thereby prevent any possibility of fatigue. This is the procedure we have followed on this lightweight box car.

There is another very interesting feature and that is the effect of impact as far as stresses are concerned upon the underframe and superstructure. Except at very low car impact speeds, which closely approach static conditions, the stresses are largely confined to the members of considerable cross-sectional area, presenting the most direct path for the transmission of the blow. The side sill and the floor stringers on an A.A.R. box car develop under usual operating conditions an infinitesimal stress as compared with the center sill which is in the direct path for impact forces transmitted through the coupler. This applies evidently to all types of construction even though the members are relatively held in place by the flooring. When the resultant line of buff or impact at the end of the car is raised due to the coupler horn hitting the striking casting it creates in the floor stringer and side sill considerably more stress but even then a fraction of the stress per sq. in. which occurs in the center sill. This brings out the fact that it is erroneous to give any great consideration under impact to the longitudinal members of the underframe other than the center sill as resistance to car impacts through the coupler.

Further indications point out that any buffing force that is applied along the underframe line has very little resistance from the superstructure. The fundamental of design is that under an impact on the underframe any use of metal or cross-sectional area in members other than the center sill to withstand buffing impacts is not an economic use of the material.

We have gone to the extreme to make these tests to

determine just what are the stresses due to the impact blows at the end of the underframe of both passenger and freight cars and to prove the truth or the fallacies of the many theories that have been advanced in connection with lightweight car design and construction, so that proper protection may be provided to the passengers, lading and structure under these severe conditions.

The impact recording gages indicate that the coupler shank in all cases starts to deform at speeds well below where car PLM No. 501, the car we have exhibited this year, shows any stresses near the yield point. At impacts of 10 m.p.h. the coupler shank had been stressed beyond the yield point of the material.

There seems to be a very marked effect on the stresses recorded in the framing members due to the characteristics of the draft gear. This is very clearly shown in various sets of impact readings which have been made with conventional draft gear and draft gear which produces better cushioning than the conventional gear. There are instances where the stress yield point was exceeded in certain members of the car structure with the conventional draft gear at impact speeds of 10 m.p.h. or a little less. With an improved cushioning device—which is really the office of the draft gear—we have readings which indicate that this point is reached at about 12½ m.p.h.

It has been the aim of our company constantly to study and analyze all the factors that enter into car design and construction. Then by means of the most exhaustive tests in the laboratory, on the test track and in service assure you as well as ourselves that equipment built as a result of these efforts will answer all operating requirements, have low maintenance costs, and have a satisfactory length of life.

Kansas City Southern Freight Locomotives

(*Continued from page 559*)

Rods, Tandem, articulated rod drive	Lima Locomotive Works, Lima, Ohio
Piston-rod packing, Crescent tandem type	T-Z Railway Equipment Co., Chicago
Piston-valve bushings; cylinder bushings; piston bull rings and Duplex sectional cylinder packing rings; valve bull rings and Duplex sectional valve-packing rings	Hunt-Spiller Mfg. Corp., S. Boston, Mass.
Power reverse gear, Type B	Franklin Railway Supply Co., Inc., New York
Brake equipment, Schedule 8-ET	Westinghouse Air Brake Co., Wilmerding, Pa.
Brake shoes	American Brake Shoe & Foundry Co., New York
Foundation brakes	American Brake Co., St. Louis, Mo.
Driving-box lubricator and spreader	Franklin Railway Supply Co., Inc., New York
Hydrostatic lubricator	Edna Brass Mfg. Co., Cincinnati, Ohio
Mechanical lubricator	Detroit Lubricator Co., Detroit, Mich.
Injector	Manning, Maxwell & Moore, Inc., Hancock Valve Division, Bridgeport, Conn.
Injector check	Edna Brass Mfg. Co., Cincinnati, Ohio
Steam and air gages	Ashton Valve Co., Boston, Mass.
Steam-pipe casing, Reid	Lima Locomotive Works, Inc., Lima, Ohio
Water column	Prime Manufacturing Co., The, Milwaukee, Wis.
Water gage, Type BX-5	Nathan Manufacturing Co., New York
Steam valve	Manning, Maxwell & Moore, Inc., Hancock Valve Division, Bridgeport, Conn.
Steam-heat equipment and valve	Gold Car Heating & Lighting Co., Brooklyn, N. Y.
Valves	Wm. Powell Co., Cincinnati, Ohio
Cocks	T-Z Railway Equipment Co., Chicago
Bell ringer, Gollmar	U. S. Metallic Packing Co., Philadelphia, Pa.
Throttle, Multiple type	American Throttle Co., New York
Speed recorder, indicating and recording type	Valve Pilot Corporation, New York
Sanders, Type BW	Morris B. Brewster Company, Chicago
Boiler-water treatment, Model C Gunderson process	Dearborn Chemical Company, Chicago
Clear-vision windows and windshield glass (safety)	Libby-Owens, Ford Glass Co., Toledo, Ohio
Side ventilators and engineer's seat	Gustin-Bacon Mfg. Co., Kansas City, Mo.
Headlight and generator	Pyle National Co., Chicago
Radial buffer, Type E-2	Franklin Railway Supply Co., Inc., New York
Flexible joints and pipe connections between engine and tender	Barco Manufacturing Co., Chicago
Unit safety bar between engine and tender	Franklin Railway Supply Co., Inc., New York
Tender:	
Frame, water-bottom type	General Steel Castings Corp., Eddystone, Pa.
Brake shoes, Diamond S	American Brake Shoe & Foundry Co., New York
Draft gear, friction type	W. H. Miner, Inc., Chicago
Truck, six-wheel	Buckeye Steel Castings Co., Columbus, Ohio
Truck springs	American Locomotive Co., Railway Steel Spring Div., New York
Friction snubber spring	Cardwell Westinghouse Co., Chicago
Bearings, truck, roller type	SKF Industries, Philadelphia, Pa.
Wheels, rolled steel, multiple wear	Edgewater Steel Co., Pittsburgh, Pa.
Tank valves	T-Z Railway Equipment Co., Chicago
Tank, top, sides and end plate, Cor-Ten	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Brakes, Simplex unit cylinder clasp	American Steel Foundries, Chicago
Coupler and yoke	Buckeye Steel Castings Co., Columbus, Ohio

Exhaust Steam Injector A Correction

The exhaust-steam injector of The Superheater Company, referred to in the Railway Fuel and Traveling Engineers' Association report on Improved and New Locomotive Economy Devices, will handle feedwater as hot as 105 deg., not 150 deg. as stated on page 480 of the October *Railway Mechanical Engineer.*

Fire drill on the Illinois Central—A fleet of 350 Illinois Central locomotives has been equipped with fire-fighting apparatus

EDITORIALS

Railway Mechanical Engineer Index for 1937

Entries for the material published in the Daily issues of the Railway Age, the first published at the Atlantic City conventions of the Mechanical and Purchases and Stores Divisions of the Association of American Railroads in June after a lapse of seven years, will be included in the 1937 index to the *Railway Mechanical Engineer* now being prepared. Being a subscriber to the *Railway Mechanical Engineer* does not insure your receiving the index. Our mailing list includes only those to whom the 1936 index was sent. New or old subscribers who did not receive a copy for that year are asked, therefore, to send in their requests as promptly as possible if they desire the 1937 and future indices.

Advance in Car Design

Early in October, 1937, a series of impact tests on the Pullman-Standard Car Manufacturing Company's lightweight, all-welded box car, PLM No. 501, and a standard A.A.R. box car was conducted by the Division of Engineering Research, Association of American Railroads. The results of these tests, set forth in preliminary form in Division of Engineering Research report No. 64, issued on November 1, mark two distinct advances in the field of freight-car design, one of them specific and the other of wide general import.

The tests show clearly that full advantage can be taken of the superior properties of the high-tensile structural steels for weight saving in a car structure without sacrifice of capacity to withstand rough usage. As a matter of fact, the lightweight box car, notwithstanding that it weighs 10,000 lb. less than the 1932 standard box car, in comparison with which it was tested—a reduction in weight of 22 per cent—withstood higher impact speeds before stresses were recorded which exceeded the yield point of the Cor-Ten steel than the A.R.A. car could withstand without exceeding the yield point of carbon steel at certain locations in the structure.

This should not be interpreted as a reflection on the A.R.A. standard design. These tests, as well as earlier impact tests, all indicate this design to be well balanced and probably about as highly refined as can be expected using carbon steel and fabricating by riveting.

The results of these tests would seem definitely to remove any question as to the practicability of the use of the higher-strength materials in thin sections and as to the effectiveness of welding as a means of producing a structure capable of acting as a unit under the severest kind of punishment. Of wide general import is the use made of the de Forest strain gages in determining stresses at 125 locations on the lightweight car. As the report points out, the results of the extensive data obtained in these tests have already cleared up certain points with respect to the action of the car structures in service which it has been impossible previously to know with certainty. Such a determination is the fact that combined stresses due to the dead load of the structure and the live load of the lading when the car is standing are very much lower than those due to horizontal impact, a condition which prevailed even when the horizontal impacts occurred at low speeds. The extensive use of these strain gages in design checking will prove invaluable in hastening and cheapening the process of perfecting new designs. By their use a balanced design can be achieved without the trial-and-error method of observing failures in service before determining the points which need strengthening to bring the design into balance.

The new technique of determining stresses at numerous points in a structure under impact removes a wide area from the field of uncertainty with which equipment designers now have to reckon.

New Tools Needed To Prevent Losses

One fact clearly brought out during recent months when the railroads experienced traffic volume approaching 900,000 cars per week was that they were gradually reaching a point where the lack of equipment buying during the depression years was beginning to show up the inability to handle traffic economically. This was indicated by the necessity of bringing back into service motive power that, by comparison with modern power, is certainly to be considered obsolete and by the fact that the increasing pressure of repair work on the shops made it obvious that many of the older units of shop equipment are no longer adequate to meet the demands of production volume and quality workmanship. Many roads took advantage of increasing income to start programs of shop rehabilitation by the purchase of new equipment to replace the obsolete units. The present recession in general business, resulting in traffic decreases, and the awarding of wage increases to railroad labor have combined to slow up these programs of equipment buying and have resulted, in addition, in curtailment of employment, and, consequently, repair work.

The continuance in service of mechanical facilities

which have outlived their usefulness as far as economical performance is concerned results in a decided loss, amounting to positive waste, to the company or the industry that is involved. A business, to be considered successful, must be operated at least within its income and a railroad is no exception. The prices which a railroad must pay for labor are fixed by agreement and the revenues are governed by rates and volume of traffic. When traffic volume decreases so does revenue and so likewise must expenditures. Under such circumstances it is possible for a railroad to pay for just so many hours of labor and the ultimate restoration of locomotive-miles to active service through the medium of repair work is in direct relation to the hours worked and—the adequacy of the facilities. In a well-equipped, well-supervised repair shop any given number of man-hours will restore more locomotive-miles to service than is possible in a poorly-equipped shop—no matter how well it may be supervised. In addition to the speed with which work may be performed there is also the very important factor of the quality of workmanship. This has a decided influence upon the amount of service that can be obtained from the motive power out on the road.

Conditions in many shops have reached a point where a substantial part of the shop equipment can definitely be classed as obsolete and is unable to perform the task of producing its expected share of work in relation to the amount of labor expended in its use. In other words, the obsolete tool makes it impossible for a workman to produce as much as his effort justifies.

Where a large part of the shop equipment inventory is made up of inefficient units it becomes increasingly difficult to maintain motive power and cars in condition for service at a cost within the ability of a road to pay. The result is under-maintenance and expensive delays to service. A policy which in the long run results only in the deterioration of a property through the inability to effect adequate maintenance is the surest way to bring about losses to both labor and capital. The roads should continue a program designed to replace obsolete equipment because, with limited revenues and increased costs, the necessity of assuring adequate maintenance at the lowest possible cost is more urgent than when the spread between income and expense is greater. Labor has a vital interest in the modernization of a property for a careful analysis of the effects of obsolescence will show that inadequate tools and equipment actually stand between the workman and his long-range interests. In a competitive situation they weaken the industry on which he depends for a livelihood.

Contrary to the belief that modern facilities wipe out opportunities for employment, expenditures for new equipment will have relatively little effect on the total amount distributed in wages. It will, however, have a decided effect on the amount of serviceability restored to locomotives and cars for every dollar expended for labor.

Intelligent reductions of operating costs through modernization are the best assurance that the railroads will continue to serve the public as successful private enterprises.

Is the Locomotive Inventory Adequate?

Throughout the past eight years since the beginning of the general business recession and, in fact, for several years prior to that time the number of locomotive units in the motive-power inventory of the Class I railways has steadily declined. From approximately 60,000 locomotives on line at the beginning of 1928, the number had dropped to approximately 43,500 this fall.

The removal of approximately 16,500 locomotives from the bottom of the inventory has not reduced the aggregate capacity at all in proportion to the number of units involved. The locomotives removed were mostly of ancient vintage and of relatively small capacity. Furthermore, during the years of declining traffic no question of the adequacy of motive-power capacity was raised by the declining number of locomotives because the drop in traffic volume was in so much greater proportion.

In 1928 and 1929 the average monthly mileage of active locomotives during the fall peak of traffic was 2,239 and 2,266, respectively. In 1929, 85 per cent of the total number of locomotives on line were in active service during the peak month. In October, 1932, the average miles per month of the active locomotives averaged 2,160. Furthermore, with over 10,000 locomotives stored and almost 9,000 out of service awaiting repairs, only 63 per cent of the total number on line were actually in service. A year later, with a slight increase in the total number of road-locomotive-miles, the average miles per active locomotive was 2,080 and the active locomotives during October of that year represented but 67½ per cent of the total number on line.

Coming to 1934, with practically the same total locomotive miles as in the preceding October, each active locomotive averaged 2,200 miles, and but 67 per cent of the total number of locomotives on line were in active service. In point of intensity of utilization of the active locomotives, the fall peak of this year represented a return to the conditions which prevailed during 1928 and 1929, but with 10,600 locomotives in unserviceable condition and with over 5,000 locomotives stored serviceable.

In October, 1935, with an appreciable increase in total locomotive-miles over the fall peak of the preceding year, there was a definite increase in intensity of utilization over that prevailing in 1928 and 1929. There was an average road locomotive mileage of 2,360 per locomotive in active service. No appreciable reduction had been made in the number of unservicable locomotives during that year, although the number of stored locomotives had begun definitely to shrink. At

that time the active locomotives represented 69 per cent of the total number on line.

In the fall of 1936, there was again a marked increase in road-locomotive-miles over the number recorded in October, 1935, and a further increase in intensity of utilization of the active locomotives is indicated by an average mileage of 2,460. The first marked shrinkage in reserve power was also evident at that time, as the number of unserviceable locomotives had dropped below 8,400 and the number of stored locomotives to considerably fewer than 3,000. The locomotives in active service represented 75 per cent of the total number on line. During the past year this percentage increased to 79 in October because of a still further reduction in the number of unserviceable locomotives, although the number stored serviceable has increased slightly during the latter part of the year as compared with the fall of 1936. The disappointing recession in traffic during the late summer and fall, however, resulted in a drop in total road-locomotive-miles and a return in point of intensity of utilization approximately to the figures of the peak months of 1928 and 1929.

The figures indicate that the reserve supply of motive power at the present time is barely adequate to meet a definite upturn in traffic when such an upturn comes, as it inevitably will. They do not, however, give any indication of the quality of the motive-power units themselves, either as to individual capacity or effectiveness to meet modern traffic conditions. Most of the motive-power units removed during the past ten years had long passed their effective life and a relatively small number of the locomotives at present on line have been installed within the past ten years. It can scarcely be doubted that further increases in the number of active locomotives will be by units still far from modern in adequacy and efficiency. It is probable that such further increases will lower the intensity of utilization which it will be possible to average as total locomotive mileage increases.

Do Roller Bearings Reduce Wheel Slip?

An important part of the cost of maintaining locomotives is represented in the expense involved in taking equipment out of service for the turning of driving-wheel tires. The mileage secured between tire turnings varies greatly with the class of equipment and type of service, the best performance in heavy fast passenger service usually ranging from 70,000 to 100,000 miles per tire turning. Not infrequently, however, excessive wear due to "quarter slip", the development of sharp flanges, or some other cause, reduces this mileage 50 per cent so that locomotive driving tires have to be turned after only 35,000 to 50,000 miles.

The subject of "quarter slip" is of great importance because of the attendant excessive cost of driving-wheel maintenance and the *Railway Mechanical Engineer* will be glad to receive for publication, constructive information regarding the causes and remedies for this condition. While the subject is generally familiar to locomotive maintenance men throughout the country, there is considerable difference of opinion, for example, regarding exactly where this uneven tire wear actually occurs and to what extent excessive wear in driving boxes and rods causes it.

An interesting comment in this connection was recently made by the mechanical department head of a large railroad who said that the application of roller bearings to the main driving wheels of a certain class of locomotive which had given considerable trouble due to "quarter slip" practically eliminated the difficulty and doubled the mileage between tire turnings. The explanation of this very desirable result was that accurate fitting of the roller-bearing boxes eliminated slack action such as is occasioned in worn plain bearings and consequently, had a tendency to prevent slippage of the driving wheels when the main crank pins passed the dead center. It would be informative to know if other roads have had a similar experience and whether or not roller-bearing rods are also a helpful influence in this connection.

New Books

IMPACT TESTS OF LIGHT-WEIGHT BOX CARS. *Summary Report prepared by the Division of Equipment Research, now the Division of Engineering Research, Association of American Railroads, 59 East Van Buren Street, Chicago. 54 pages. Price to member roads $1; to others $2.*

This report was prepared at the request of the A.A.R. Mechanical Division Committee on Car Construction, on April 1, 1937, and revised October 1, 1937. The report contains the result of impact tests conducted with two experimental light-weight cars, one, built by the Pullman-Standard Car Manufacturing Company, embodying the extensive use of welded Cor-Ten Steel construction and weighing 34,200 lb.; the other car, built by the Mt. Vernon Car Manufacturing Company, being also made of Cor-Ten steel but with riveted construction throughout and weighing 36,400 lb.

The report contains a brief description of the experimental test cars and tables of detailed comparative car weights in Part 1. A summary of the results of the tests is included in Part II and Part III describes extensometer and deflectometer tests of the Pullman-Standard car. Other sub-divisions of the report include: Part IV, Impact Test Procedure; Part V, Results of Impact Tests of Pullman-Standard Light-Weight Box Car; Part VI, Results of Impact Tests of Mt. Vernon Light-Weight Box Car; Part VII, Results of Impact Tests of A.A.R. Standard Box Cars (1933-1934); Part VIII, Distortion of Car Structures During Impact Tests; and Part IX, Performance of Experimental Light-Weight Box Cars.

Gleanings *from the* Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

Rigid Locomotive Beds

What has the rigid bed contributed to the locomotive, outside of elimination of bolting and cross braces? Due to its remaining square, has tire wear been reduced, driving box and saddle wear reduced, and a general improvement in service of machinery resulted? Is there a possibility of eliminating waist sheets with the use of engine beds?

Accident Prevention

The safety movement and the promotion of safety throughout the shop, is of vital importance to a foreman, and perhaps of first importance in the performance of his duties. I would like to see more articles on this subject in the *Railway Mechanical Engineer.* There should be articles of practical and inspirational value. These, in my opinion, would be of great personal help to foremen in the field of accident prevention.

Thank You!

It is my opinion that the October, 1937, issue of the *Railway Mechanical Engineer* is the best issue which you have ever printed. I did not attempt to read it in the office, but took it home and read every article, and while many of our staff officers receive this periodical, I have called their attention to the fact that I would like to have each and every one of them spend sufficient time to thoroughly read and digest all of the articles contained therein. I certainly wish to offer to you my sincere congratulations.

Training in Public Speaking

I have joined a public speaking club which is to meet on Monday evenings throughout the winter, and the preparation of a little speech for these occasions has occupied quite a little of my spare time. I am hoping, once I have got some experience along this line, to avail myself of an opportunity now and again of speaking on railway matters, and perhaps in that way do something to bring before groups of people a more intimate knowledge of the working of the great transportation agencies, with the interests of which the lives and welfare of so many of the best of our working men are so inseparably bound up.

Finding Out About Essentials

You may be interested to hear that the Canadian Pacific Railway is now selling to its employees a Foundation Library of ten books at a cost of but two dollars, to assist its employees to gain a solid, clear understanding of the foundations upon which the whole fabric of our economic system is built, and with special emphasis upon just the part that our transportation facilities have played in the building. This was done to promote the spread of education amongst employees, in order that the men might have a clearer understanding of the factors involved when matters dealing with the relationships between management and men are under discussion.

Concerning Roller Bearings

Roller bearings are established, but I wonder what different roads are doing to maintain and replace them. Will they call on the manufacturers for replacement parts calling for finishes in ten thousandths of an inch, or will they undertake to furnish these parts themselves, with the possibility of requiring special machinery to carry on this work? Some of the roller bearings on axles of large diameter prevent the pressing off of wheels in the ordinary wheel press, and modifications in the usual method of pressing off wheels will be necessary. There appears to be a lack of information on the resistance of roller bearing locomotives, and without doubt such applications will make obsolete the old formula for locomotive resistances.

Antiquated Enginehouses

The mechanical department has always been considered a non-revenue part of the railroad make-up, and as but few operating officers have come from the mechanical department, they think in terms of modern locomotives when giving consideration to economies. The result has been that the railroads have gone exceedingly far in providing the American public with highly efficient locomotives. It is true that these locomotives reduce operating costs, but a good deal of the savings can easily be lost when these locomotives are placed in the roundhouse for having repair work performed. In other words, we have roundhouse equipment of 1910 attempting to handle locomotives of 1937. In my opinion railroads can increase revenues not alone by obtaining increased traffic, but also by reducing maintenance costs. If as much energy had been spent in reducing maintenance costs as has been spent in reducing operating costs, I believe the railroads would have made a much better showing in the face of reduced traffic.

An Investment and a Challenge

Anyone who will think seriously for a moment about the situation in which the railroads of the country find themselves, cannot help but be deeply concerned about their future. At the moment, much hope is being pinned upon relief by means of rate increases, but all hope should not be confined to this possible way out. There is another avenue open, which, if intelligently exploited, also offers substantial promise. What it all gets down to is simply this. Within the last several months the railroads have, in essence, agreed through the processes of mediation to invest an additional $135,000,000 annually in the service and good will of their employees. Their employees are effectively led and represented through 21 railroad labor organizations. It is through these organizations that the $135,000,000 pay increases have been accepted by the million and a quarter employees of the industry. Such being the case, what has the industry and the public a right to expect by way of improved performance, better service and increased efficiency, and how should industry and its employees go about securing the desired results? This, as I see it, is the challenge that confronts the railroads, their employees and labor organizations.

IN THE BACK SHOP AND ENGINEHOUSE

Performance of Vascoloy Tools in Boring Tires

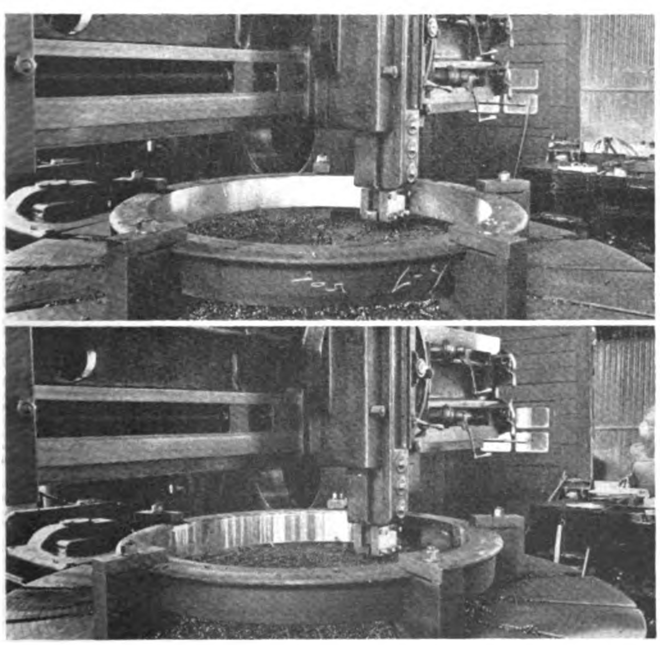
An eastern railroad, believing that a rough and scaley finish at the wheel fit of driving-wheel tires might be the cause of progressive fractures resulting in tire failures, investigated the possibilities of boring the tires with a mirror finish by using Vascoloy-tipped tools. Experiment proved that it was impossible to obtain a polished finish with high-speed tool steel for the reason that such steel will not hold its edge at speeds in excess of 66 ft. per min., which speed resulted in relatively rough surfaces showing clearly the marks where the metal was torn at irregular points.

Performance of High-Speed and Vascoloy-Tipped Tools When Boring 50-in. Tires

Tool	High-speed steel	Vascoloy tipped*
Surface speed for roughing cut, ft. per min.	60	190
Feed for roughing cut, in.	3/32	1/16
Roughing cut, in.	1/16 to 1/4	1/16-1/4
Surface speed for finishing cut, ft. per min.	66	320
Feed for finishing cut, in.	1/16	1/16
Finishing cut, in.	1/16	1/16
Tires bored per grind, roughing tool	3	7
Tires bored per grind, finishing tool	1	15
Cutting time per tire, min.†	47†	27†

* Style No. 12 Vascoloy-Ramet tool used for roughing cut; Style No. 16 used for finishing cut.
† Time includes boring tires and cutting retaining ring grooves.

Realizing that high-speeds were necessary to produce the desired mirror-like finish, this railroad is now using Vascoloy-tipped tools and is making roughing cuts at a speed of approximately 190 surface ft. per min., and finishing cuts at a speed of approximately 320 surface ft. per min. while boring driving wheel tires. The accompanying table compares speeds, feeds and the performance of high-speed tool steel and Vascoloy-tipped tools when boring 50-in. driving tires. The illustration shows a finish tire bored with high-speed tool steel and another tire bored with a Vascoloy-tipped tool; although the illustration indicates the mirror-like finish of the tire bored with a Vascoloy-tipped tool, the differences in the finishes as observed on the job is much more apparent, the finish obtained with Vascoloy being perfectly smooth while the finish obtained with high-speed tool steel is decidedly rough.



Top: Tire finish-bored with high-speed tool steel. Bottom: Tire finish-bored with Vascoloy-tipped tool. This unretouched illustration was taken under actual shop conditions and without the aid of artificial lighting

Although this particular application of cemented-carbide tools was made primarily to produce a finish which would eliminate what is thought to be one of the causes for tire failures, the results of the machining operations has proved the possibility of effecting economies in production methods by using these cemented-carbide tools. With the increase in surface speeds, the production of tires has been increased. Also, the number of tires bored per tool grind has been increased, thus effecting further economies in time used for changing and grinding tools on this particular operation.

Welding with Coated Electrodes*

By J. A. Coakley, Jr.†

The broad use of electric-arc welding in the fabrication and repairing of locomotives and cars has been made possible by (1) the study of welding by the roads themselves with intelligent application of the process, and (2) the steady progress brought about through extensive research and development on the part of the manufacturers of welding equipment. The development which has probably done more than any other single thing to stimulate progress of welding has been the introduction of the shielded-arc method. Developed and progressively improved, the shielded arc has been a great aid in removing the doubt which existed for a long time regarding the strength of welded joints. This process made it possible to produce welds actually exceeding mild rolled steel in physical properties. For the sake of comparison, the physical properties of welds made with both bare and shielded-arc electrodes, are given in the accompanying table.

Physical Properties of Welds Made with Bare and Coated Electrodes

Property	Coated electrode	Bare electrode
Tensile strength, lb. per sq. in.	70,000	47,000
Ductility, per cent elongation in 2 in.	25	6
Density, grams per c.c.	7.84	7.6
Fatigue resistance, lb. per sq. in.	30,000	13,000
Impact resistance, ft.-lb. Izod	50-80	8-15
Resistance to corrosion	Greater than mild steel	Less than mild steel

Because of the improved results obtained by the

* Presented at the annual meeting of the Master Boiler Makers' Association at Chicago, September 30, 1937.
† Vice-President and Secretary, The Lincoln Electric Railway Sales Company, Cleveland, Ohio.

shielded-arc process of welding, safety is assured in welded construction and we find here the reason why electric welding is being employed increasingly by the railroads. All the world is watching with great interest the experimental tests which are being conducted by a large eastern railroad in conjunction with one of the locomotive builders in an effort to determine the practicability of an all-welded locomotive boiler which has been fabricated largely with shielded-arc electrodes. It might be mentioned here that great attention is being given to the subject of stress-relieving of welded joints on this particular job in an effort to determine whether

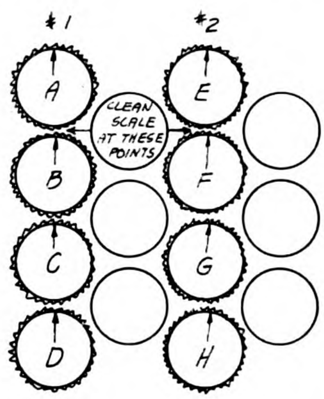


Fig. 1—Section of flue sheet illustrating flue-welding procedure

or not this procedure is necessary, and if so to what extent and through what means.

One simple fact accounts for the greatly improved physical properties of shielded-arc welds (those made with coated electrodes). In the shielded-arc process, the coating of the electrode, as it is consumed in the arc, produces a gas which envelopes the arc and weld metal and protects it from the surrounding atmosphere which contains oxygen and nitrogen. This protection prevents formation of oxides and nitrides as it is the presence of these impurities in unshielded-arc-weld metal which embrittles and weakens the welds. The improved quality of the welding is not the only advantage provided by the shielded-arc process. The other result—and the one

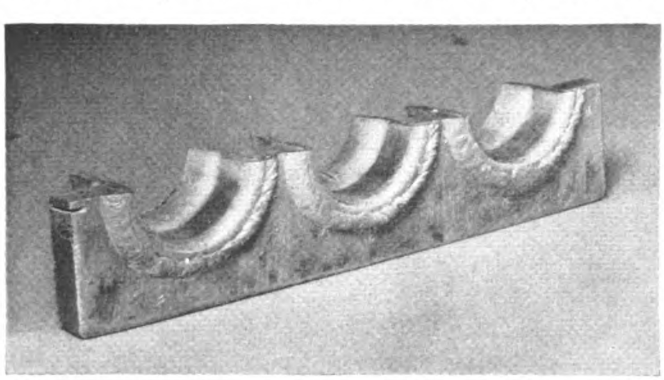


Fig. 2—Section of flue sheet in which the tubes have been welded with both bare and coated electrodes

which accounts for the greater economy of modern electric welding—is the effect on welding speed.

Savings with Coated Electrodes

Each day boiler men on the railroads are becoming better acquainted with the advantages which are found in the use of coated electrodes. However, many roads because of lack of funds have not been able to increase the number of welding machines in their shops in proportion to the greater demand for this additional equipment and it has fallen upon the men in charge of getting the work out to make a more efficient use of the facilities at hand. It can safely be said that there is no other means which will aid them more readily in the accomplishment of this end, and at the same time with no additional expense, than that which is afforded by the use of the shielded arc electrodes. The author will attempt to show later how the cost of welding can actually be reduced with this type electrode, but for the present will consider only the savings in man-hours alone.

It is conservative to say that there will be savings of at least 30 per cent in man-hours employed if coated electrodes are used in connection with the welding of flues and tubes to the back flue sheet of a locomotive boiler. Here are figures from an actual application on a mid-western road. A locomotive with 261 flues and tubes was welded in 8½ hrs. using a 5/32-in. coated electrode. It was learned later that it had previously taken from 18 to 20 hrs. to weld this same set of flues with bare rods. Another example is of a locomotive boiler having 253 2-in. flues, 36 superheater flues, and eight 2-in. air tubes which was welded in 7 hrs. 15 min.; 18½ lbs. of 5/32-in. coated wire were used. There are some railroads on which it is a practice to weld flues with 1/8-in. electrode, and with this diameter wire a set consisting of 244 2¼-in. flues and 53 superheater flues were welded in 8½ hrs. During a test which was made at the Collinwood shops of the New York Central System in December, 1936, one of the regular welders completed 45½ 3¾-in. flues in one hour.

While 5/32-in. electrodes are usually employed for this work, mention was made of one instance in which 1/8-in.

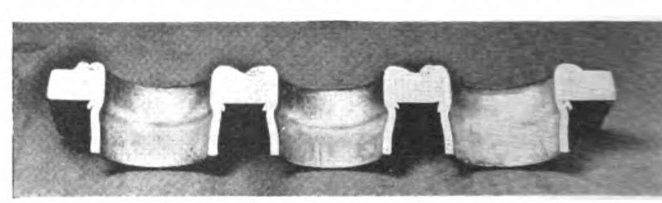


Fig. 3—The flue-sheet section from the side opposite that shown in Fig. 2—Note the porosity in the welds made with bare electrodes

wire was used, particularly where there are many 2-in. and 2¼-in. flues. One advantage of the 1/8-in. size is that it produces a rounder bead on the smaller flues. It also prevents overlapping of the welds at the bridges which are sometimes very narrow when small diameter flues are being inserted.

Using a 5/32-in. straight polarity shielded-arc electrode it is possible to weld one 3-in. flue per minute and 10 flues in 10 min. Owing to interruptions for changing positions, etc., it will not be possible to keep up the rate mentioned until the entire set has been completed but the author has seen as many as 58 3-in. flues welded in one hour.

Preparation of the Work

1.—In preparing to weld with coated wire it should be seen at the outset that all the flues and tubes are properly applied. When old flue sheets are used it is necessary to have all of the old weld metal removed.

2.—When the flues are expanded it is recommended that soap be used as a lubricant for the reason that oil will create porosity in the weld metal. The heat of the arc seems to act upon any oil present, creating a gaseous condition in the molten metal which produces a porous state when the metal is cooled. Of course, some roads

use a solvent to clean the flues when oil has been used as a lubricant but the objection presented in such a case is that the cleansing compound does not get under the beads and any trace of oil which is not removed will cause porosity.

3.—Caution must be exercised to see that the copper ferrules are set back the proper distance from the face of the flue sheet, which in most instances is $\frac{1}{32}$ in. When the copper extends beyond the limit mentioned there is a great possibility of it becoming mixed with the weld metal which will cause hardness in the deposit and the result will most always be a cracked flue bead. It must be borne in mind that, with coated electrodes, it is necessary to use higher welding currents which, while affording greater speed, will also cause deeper penetration of the weld metal, making it quite necessary to see that the ferrules are inserted properly. This deeper weld is at the same time more ductile and has a greater resistance to shock and may possibly lead to the complete elimination of the copper ferrule.

Attention has previously been directed to a method of welding boiler flues to the back flue sheet which eliminates the use of the copper ferrule.* Certainly such a method is more adaptable to the use of coated electrodes.

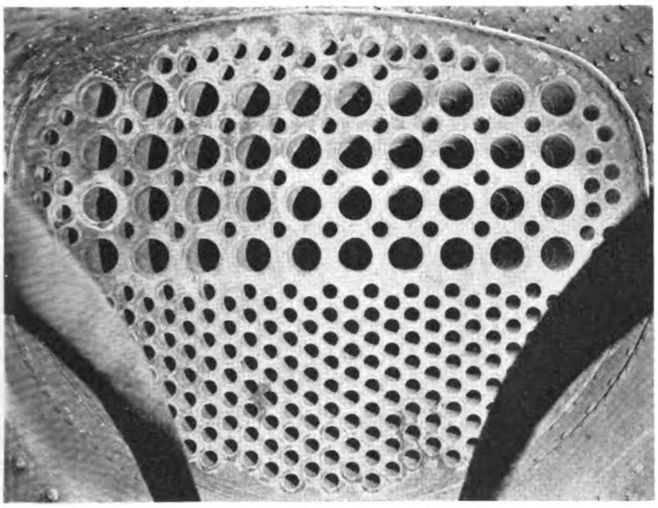


Fig. 4—Boiler flues welded with coated electrodes

In this method the holes in the flue sheet are beveled, the flues are then inserted to within $\frac{1}{16}$ in. of the face of the sheet and expanded. Then by using a special tool the ends of the flues are flanged onto the beveled sides after which they are welded. It is understood, however, that this method of welding flues will be successful providing water conditions are good.

4. Before the welding is begun it is recommended that the flues be sandblasted. This may be done before or after the flues are beaded but for a perfect job in which you want to be absolutely certain that there is no dirt, mill scale or other foreign matter present to impede the progress of the welding and cause impurities in the welds, it is better to sandblast before the flues are beaded. In certain instances, flues are not welded by some railroads until after the engines have been fired. If such be the case it is quite necessary that the entire flue sheet be sand blasted before welding is started.

Welding Procedure

Some railroads weld flues with water in the boiler in which case the heat is dissipated more rapidly than when

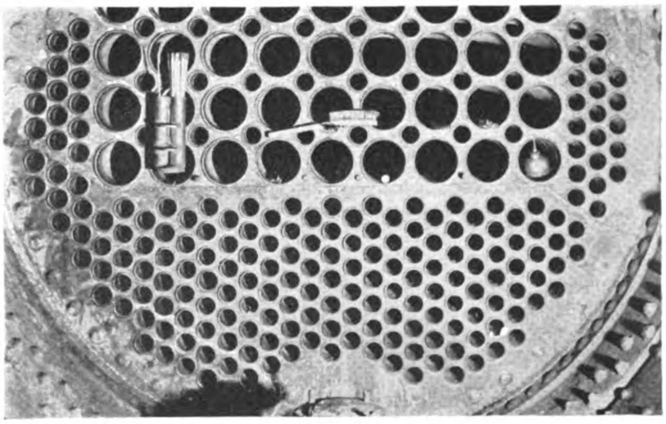


Fig. 5—A ¾-in. front flue sheet welded-in without removing rivets

the boiler is dry and it is possible to move along without making any allowance for the effect of the heat of the arc upon the flue sheet. Assuming, however, that most flues are welded with the boiler dry, (during which time care must be taken to see that the heat is not concentrated too long in any area on the sheet), the following procedure is outlined:

1—Fig. 1 shows appearance of section of flue sheet with flues.

2—Start the arc on row No. 1 of flues at top of *A* proceeding downward to *B* and continuing *C, D*, etc., taking half a flue at a time. After welding eight or ten flues in this manner, jump over one or two rows and follow the same procedure as on row No. 1.

3—After row No. 2 has been welded, the first row of flues will have cooled sufficiently and the operator can go back, clean scale off welds at the top and bottom of each flue and weld the other half of the first row (*A, B, C*, etc.). When welding the second half, the weld should be overlapped at the top and bottom of the flue at least ⅜ in., or in any event enough to make certain that the fusion is perfect.

4—Skip over two rows from No. 2 to where No. 3 would be and follow the original procedure outlined previously in paragraph No. 3. Then return and finish the second half of row No. 2.

5—This procedure should be continued until all flues are finished. It is not necessary to clean the scale from the flue welds where no further welding is to be done as firing the locomotive will burn it off.

6—If the job is to reweld flues where the original weld has cracked, remove *all* of the original weld metal, clean the sheet and flues carefully, and proceed as previously outlined.

7—If the crack extends into the flue sheet, open up the crack and be sure to open it up at least ¼ in. beyond the apparent end of the crack, then V the crack in the sheet and proceed as for an ordinary butt weld. The weld bead should be as high as the flue bead and slightly rounded. It has been found the tendency of hollow beads is to crack. Where a bead cracks it has been found nine times out of ten to be due to one of two things: Either a shallow bead of weld metal or to the ferrules extending out too far.

In holding the electrode during welding it is advisable to direct the arc against the sheet rather than the bead of the flue. This keeps the heat away from the thin tubes and prevents cutting the metal. It is good practice to hold the electrode at an angle that will cause the flux to be blown backwards, providing a good clean weld. Good results are obtained when the electrode is held at an angle of 45 deg. to the flue sheet and an angle of

* "Safe-Ending and Applying Flues and Tubes," *Railway Mechanical Engineer*, October, 1937, p. 497, Fig. 3.

from 75 deg. to 85 deg. to the angle of the bead. Welding current a little higher than those ordinarily used is advantageous in this work.

The reason for the higher current is to insure an equal burn-off of both rod and coating as insufficient current will cause the rod to burn inside the coating. The operator can observe the flow of the coating on top of the weld and determine whether or not enough current is being used. High currents assure good penetration and clean welds. Another thing to bear in mind is to hold an arc as short as possible, since a long arc tends to flatten out and cause a shallow weld.

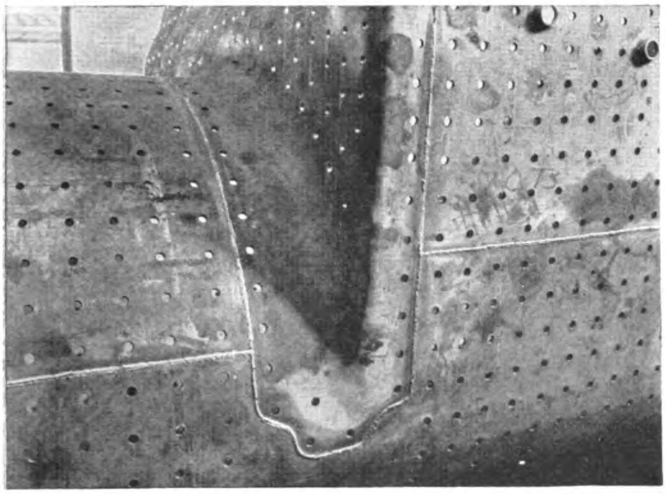


Fig. 6—Firebox completely welded, ready for assembling in the shell of the boiler

Figs. 2 and 3 show two views taken of a sample flue-sheet section in which three flues have been welded—one side with bare electrode and the other side with coated electrode. After the welding was completed the section was sawed across the middle and etched in acid in order to show a comparison of the shapes and compositions of the metal in the beads produced by the two electrodes. The bead on the right, looking at Fig. 2, was made with bare electrode while that on the left was made with coated rod. Note the smoothness of the bead, the penetration and the homogeneous grain structure of the weld which was made with the coated electrode.

Fig. 3 shows porosity in the welds made with bare electrodes; note the absence of porosity in shielded-arc welds.

Welding of Side Sheets

The type of weld recommended in firebox side-sheet construction is the single vee butt weld using a 30-deg. bevel on both sheets. The fitup should be as uniform as possible and should not be less than 1/8 in. or more than 3/16 in. It is well to tack the two sheets with a small bead about every 12 to 15 in. along the seam to be welded. The first bead is usually deposited with a 1/8 in. electrode in order to insure proper penetration of the weld through to the water side where the weld should be clean and flush with the sheet. This is made certain on a new firebox by taking a round-nose chisel and Veeing the weld out on the water side after the weld on the fire side has been completed. After this has been done a single bead is deposited in the vee to create a smooth surface. When a patch is applied, this will not be possible and visual inspection of the water side of the weld through the staybolt holes will be necessary to make certain that perfect penetration has been obtained.

After the first bead on the fire side has been deposited with 1/8 in. electrodes, 5/32 in. rods can be used applying each layer across the entire length of the seam until the weld has been completed. Each layer should be thoroughly cleaned of all scale before another one is deposited.

Cost of Deposited Metal Should be Considered

Though the cost per pound of the shielded-arc electrode is somewhat higher than that of bare electrodes, the cost per pound of metal deposited will be approximately 30 per cent less, because the increased speed which is permitted with coated wire. In fact, if it were possible to receive bare rod free, it would still be more economical to purchase coated rod.

When welding in fire boxes, in addition to the faster speed and resulting economy, shielded-arc electrodes provide the highest possible quality of weld metal which assures a safety factor from 10 to 15 per cent higher than that possible with bare electrodes. This is due to the higher physical property of the weld produced by the shielded arc. It is greater in tensile strength, higher in ductility, more resistant to shock, impact and fatigue and at the same time it is more resistant to corrosion.

This is particularly noticeable when firebox sheets are being renewed upon examination and comparison of welds made with the two types of electrode.

Examples of Savings with Weldings

Following are some examples of the advantageous use of electric welding in reconditioning locomotive boilers:

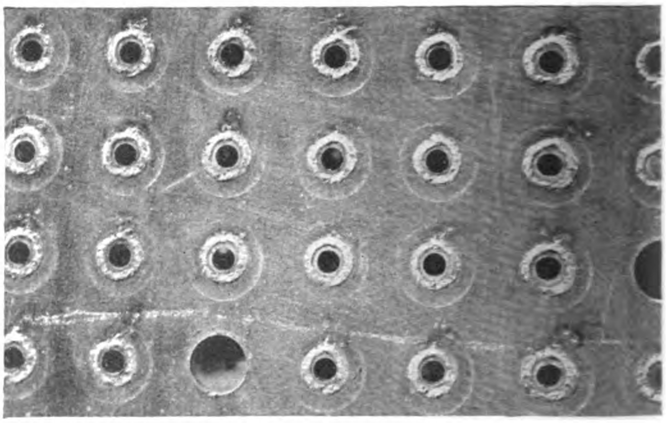


Fig. 7—Renewing staybolt holes by welding in tapered bushings, then drilling and tapping threads; 35 holes prepared per hour

Fig. 4 shows a set of flues welded with coated electrodes.

Fig. 5 illustrates a job which has seldom been done, and one which never would have been attempted without the assurance of high quality provided by coated electrodes. It is a 3/4-in. front flue sheet welded in without removing any of the rivets. It was welded with coated electrodes in a series of small beads. Each bead was cleaned of all slag before the welder applied the next one.

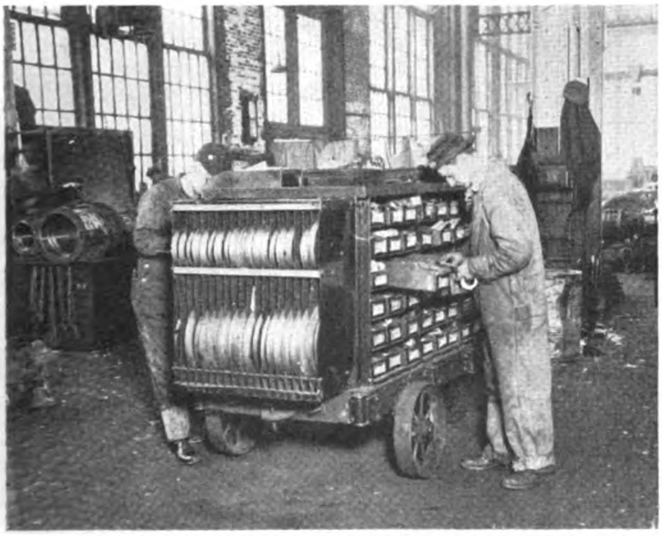
Fig. 6 shows the outside of new firebox completely welded, ready for assembling in the shell of the boiler.

A new method of renewing staybolt holes is illustrated in Fig. 7. The old method was to fill up the worn holes with weld metal and then drill new holes and tap threads. With the old method, it was possible to do about 8 holes per hour. With the new method, 35 holes are done per hour. Procedure is as follows: The old hole is reamed to take a tapered bushing. The

bushing is welded in, using coated electrodes. Welding is started at the top, proceeding downward, welding first one half and then the other, cleaning slag off between. A large bead is not necessary as the taper takes care of the pull, the purpose of the bead being that of seal. The bushings are made at low cost and can be renewed simply by knocking them out and replacing them. Another advantage is that there is enough stock to put in an oversize staybolt if this is found to be a desirable procedure.

Traveling Material-Handling Wagons

A type of material-handling wagon now being used with satisfactory results at the New York Central shops at Beech Grove, Ind., is shown in the illustrations, one view indicating a single wagon especially equipped to handle air-brake material and the other showing four wagons designed for handling miscellaneous small materials used in locomotive repairs. These wagons are returned to the storeroom at the end of each day for checking and the replacement of depleted stock, and are sent to their respective shop departments on the following morning



Material-handling wagon used in the air-brake room

where necessary repair materials can be secured by shop men without delay.

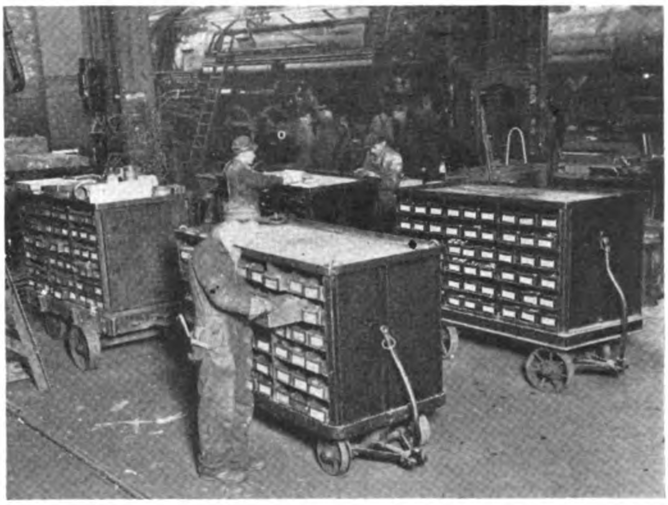
Referring to the illustration, showing four material wagons, the general construction of this new type of wagon is readily apparent. It consists of an ordinary steel or wood trailer frame mounted on wheels and having a body made of scrap steel. The body is divided into three vertical sections, each of which has six evenly spaced shelves with three drawers or boxes per shelf. Each drawer or box is 6¾ in. wide, by 16½ in. long by 4¾ in. deep, the front end being tapered down to 3 in. for hand clearance. The end is turned over ½ in. wide, forming a handle. This gives a capacity of 54 drawers on each side of each wagon or a total of 108 drawers per wagon. Some of the drawers or boxes have several subdivisions for holding very small pieces of material, thus creating capacity for a greater number of parts. One wagon has approximately 600 bins for small parts of various kinds.

Materials handled in these wagons are those commonly required in every-day use for repairing and rebuilding locomotive parts in the machine shop, air brake room, boiler shop, pipe shop and erecting shop. Parts stored in these wagons include the following: Angle valves up to 1¼ in. diameter; cotter keys up to ⅝ in. by 5 in.; grate-connecting pins, all sizes; globe valves, ¼ in. up to 1¼ in.; hose clamps up to 1½ in.; all size hexagon nuts up to 2 in.; machine bolts up to 1 in. diameter by 12 in. long; pipe ferrules; pipe nipples from ¼ in. to 2½ in. up to 8 in. long; pipe unions, ¼ in. to 2½ in.; pipe ells, ¼ in. to 2½ in.; pipe tees, ¼ in. to 2½ in.; all other miscellaneous pipe connections up to 2½ in.; all sizes and lengths of standard and steamtight studs; all common washers up to 2 in.; and staybolt sleeves and caps.

On the wagon used in the air-brake department, which has a separate compartment on either end for storing air-pump metallic packing rings of the various dimensions, such items as the following are carried: Parts for No. 9 and No. 11 Monitor injector; parts for No. 11 and No. 13 Simplex injector; lubricator parts, reverse-gear parts; water-column manifold parts; safety-valve parts; BK and Duplex stoker parts; feedwater pump parts; blow-off cock parts; air reverse, water pump and stoker packing of various sizes, and many other miscellaneous parts too numerous to quote.

Previous to the installation of these wagons, mechanics, helpers and material messengers made individual trips to the storehouse when requiring material of any kind. This required anywhere from 5 to as much as 30 minutes time, depending on the distance necessary to walk and, perhaps, congested conditions in storehouse. After the wagons were installed, this time was cut to a minimum of not over two minutes from any location in the shop, as the workmen, when requiring material, now walk to these wagons and obtain only the material they are going to need on a particular job, thus saving a considerable amount of money due to the fact that previously excessive materials were drawn from stock in order to save time and some, no doubt, found their way into the scrap.

About 2 p.m. each day the accumulated orders from the previous eight hours' business are sent to the store-



Traveling material wagons which are used successfully at Beech Grove shops

house where they are checked and tabulated on forms made for that purpose and a like amount of material is made ready to be put back in these wagons when they are returned to the storehouse (about 4 p.m.) so that the wagons are ready to take care of the demand at 8 a.m. the following day.

SOME DAYS ARE WORSE

***By* Walt Wyre**

THE S. P. & W. roundhouse at Plainville was enveloped in a gray, early morning fog that whirled and eddied in air currents around the buildings. An upward draft parted the fog like a curtain disclosing the smoke stacks of the stationary with the lower part hidden. The stacks appeared to be floating in thin air as though levitated by an invisible force.

Inside the roundhouse it was strangely quiet and the place, although full of locomotives, seemed deserted. The gentle hiss of steam from a leaky ball joint in a blow-down line and steady drip, drip of water accentuated rather than broke the silence.

The footsteps of Jim Evans, day roundhouse foreman, echoed loud on the cement runway as he walked rapidly towards the lineup board near the center of the roundhouse.

It was a few minutes past seven o'clock. The night force had gone home and members of the day force going to work at eight had not yet come on the job. Men that worked on three-shift jobs, fire builders, cellar packers, and such had their work caught up. They were hid out some place waiting for eight o'clock and time to go home. The seven o'clock machinist and his helper were making some last minute repairs on an engine on the outbound track outside.

The foreman laid the work reports for various locomotives on the home-made desk by the board, spread out as though he was dealing a hand of solitaire. On each work report a bunch of yellow work slips was fastened with a paper clip. He could tell by the thickness of the stack of slips on each work report what engineer had come in on the locomotive represented and which inspector had looked the engine over. The one with the big stack of about fifty items on the 5081, that would be engineer Hawkins. "Engine don't steam good—feed water pump won't supply the boiler—examine piston packing"—Evans knew without reading the report that those items would be listed. Hawkins can work an engine harder, get less out of it, and give more reasons for poor performance than any other old head engineer on the Plains division.

The foreman arranged the work slips in bunches for the various mechanics and placed them in pigeon holes above the desk. An occasional slip was consigned to the waste can and "O.K.—J.G.E." noted on the report. Some of the jobs thus O.K.'d should be done—Evans knew that, but trains won't run without power and there wasn't time enough to get all the work done before the locomotives had to run.

The roundhouse had been quiet at seven o'clock. At 8:15 it was a noisy bedlam of moving men, roaring blowers, stacatto chatter of air hammers and other sounds that made a busy roundhouse seem to the uninitiated like a meaningless hurly-burly of nerve racking noise.

When the men were all lined up and the work well under way, Evans went to the roundhouse office.

"Despatcher wants to double-head 82 and he wants an engine for the pile driver to go to Brady," John Harris, the roundhouse clerk, told the foreman.

Evans groaned and started back to the roundhouse. As he walked he made mental notes of engine assignments. The 1846 could be used on the pile driver. He had figured on using it on the branch line local next day. Have to figure on finishing up the 1841 that was on the drop-pit.

The foreman marked up the 1846 for the pile driver and told machinist Cox to look the engine over and do what work was necessary.

"There ain't no air pump on the 1846," the machinist reported more emphatically than grammatically ten minutes later.

"Damn—" Evans swore and bit off a hunk of "horse-shoe." "Never thought of that. The air pump was taken off to be used on the 2762 last week. Had to order some repair parts." The foreman headed for the air bench in the machine shop like the seat of his pants were on fire.

"How's the air pump off the 2762 coming along," Evans asked the air man.

"Torn down waiting on parts."

"When can I expect the air pump parts ordered last week? When you going to get some trailer wheels for a 5000?" Evans asked the storekeeper ten minutes later. "Parts for the air pump should be in day after tomorrow. Can't say about the trailer wheels," the storekeeper replied. "Thought you had an extra air pump all fixed up ready to go," the storekeeper added.

"You mean we did have one. What we have now is a cylinder casting for an air pump and it's ready for scrap. We robbed all the other parts for repairs. See if you can't rush them parts along." Evans started back to the roundhouse.

Nothing to do but take an air pump off a dead engine. That meant a lot of work. M. of E. costs were already running over and he had more work than men, but no other way out of it.

"Say, Mr. Evans, the storeroom hasn't got a middle connection brass for a 2700," machinist Jenkins told the foreman.

"Well," Evans pondered, "can't you use some other brass to make the bushing? What engine is it for?"

"The 2719," Jenkins told him.

"Let's go to the storeroom and see what they've got," Evans said.

"What's the matter? Brass foundries on a sit down strike or is it the store department?" Jim asked the storekeeper. "How about a middle connection brass for a 2700?"

"Used the last one yesterday, but—"

"Let me finish it," Evans cut in, half joking, half serious. "You'll have some in the next car! We've got to run engines today," he added.

"I'll wire for some shipped passenger," the storekeeper said. "How many will you need?"

"Order a carload and I'll figure on getting a couple." The foreman was measuring brass castings with a rule as he spoke.

One was too large inside, another too short, others too small outside. None in the storeroom could be used to make the needed bushing.

"What'll I do now?" the machinist wanted to know.

Evans measured another brass. "Take this one."

"It's too big inside," Jenkins interrupted.

"Yeah, I know, and take this one—"

"O.K.," the machinist said, "I see."

The machinist chucked the smallest of the two brasses in the lathe and bored it to fit the pin. He then took a cut off the outside of the brass. Next he bored the inside of the larger bushing so that the smaller one would fit tightly inside. Then the bushing was finished outside.

"Have you got the knuckle pin bushing finished for the 5075?" a machinist asked Jenkins.

"Not yet; about twenty minutes," the machine man said as he tightened a parting tool in the tool post to cut off the middle connection bushing.

"Hell!" the other machinist snorted. "Anybody can be slow! I've been stalling nearly an hour waiting for machine work while you fellows in the machine shop loafed."

"Yeah!" Jenkins retorted. "If I had ground in as many seat boxes as you have I wouldn't talk about anybody loafing. These new style laminated bushings take more time than the plain one-piece kind."

Things seemed to be going fairly well when the foreman took a turn through the roundhouse a few minutes before noon. He stopped at the drop-pit on his way back to the office. Ned Sparks, the roundhouse electrician, climbed down from the cab of the 5092.

The electrician was mad as a nest of hornets that had been bombarded with rocks. "That's a devil of a mess!" Sparks sputtered, jerking a thumb in the general direction of the locomotive cab.

"What's a mess and why?" Evans asked.

"Half the cab fixtures gone and the engine marked to be finished tomorrow!" Sparks snapped.

"Well, I guess you'll just have to get some new ones." The foreman reached in his jumper pocket for a pad of requisitions.

"That's just the trouble!" the electrician interrupted. "There ain't any new ones. I've had water glass and steam gauge light fixtures ordered nearly a month and haven't got them yet. Half of my time for the past six months has been put in swapping light fixtures from one engine to the other. Nearly every time I make a change some of the wires are too short and I have to put on new ones. Bet I've used enough extra wire to have bought all the cab fixtures needed."

"Take the fixtures you need off the 5089. She'll be tied up a while," Evans directed and went on to the office.

Just as the twelve o'clock whistle blew, the outbound engine inspector rushed in the office like he was an hour late and a dollar short. "Injector won't work on the 5077!" the inspector panted. "She's called for 12:45." he reminded.

By that time the rush of men knocking off for lunch had reached the clock just outside of the office. The foreman stepped to the door and waited until machinist Cox came by. Cox is the best injector man at Plainville.

"See what's the matter with the injector on the 5077," Evans told the machinist, then hurried home to lunch.

"You'll have stomach trouble eating so fast," Mrs. Evans told Jim when he started eating as though the food would evaporate in the next few minutes if not eaten immediately.

"Yeah, I'll have stomach trouble of another kind if I don't hurry. I'll be out of a job and suffering with miss-meal cramps if we have a few more delays and failures," Jim told her between bites. "I've got to get back and see about an engine that's been called for a run at 12:45."

"Well, I don't see why you don't quit! Rushing and hurrying twelve hours a day! Why don't you find another job—something easier even if it does mean less money?"

"It just happens that all of the easy jobs on the railroad are filled, besides I'm too old to hire on some other job and too young to go on a pension." Evans kissed his wife, picked up his hat, took a chew of "horseshoe" and started for the door all in less time than it takes to tell.

"Did you get the injector fixed?" the foreman asked when he reached the roundhouse.

"Have to have a new injector tube," the machinist replied.

"Did you get one?"

"No, there wasn't any in the storeroom. I was just fixing to call you and ask what engine to take one off of,"

"Rob one off the 5089. She'll be tied up a few days. I'll give the storekeeper a note to order a couple," the foreman added.

Ten minutes delay was charged against the roundhouse on the 5077. Not so bad if the train it pulled were the only one affected, but it wasn't. The fast freight had to meet other freights and passengers. Carefully circulated schedules would have to be hurriedly revised and officials are not friendly even to minor delays.

When the one o'clock whistle blew, the foreman went to the roundhouse. After seeing that every one in the roundhouse was lined up with plenty to do, he went to the storeroom to have a talk with Foster, the storekeeper. He found the storekeeper in his office checking a stock book.

"Just the man I wanted to see," the storekeeper announced when Evans came in. "When do you expect to use that booster gear? We've had it on hand nearly three months now and only used one in the past year. If you're not going to use it, we'll send it in."

"Well, I don't know. We're likely to need it most any time. Of course, we don't use many of them, but when we need one, we need it quick," Evans replied. "Looks like we should have one on hand for protection."

"If we did that with everything, just look at the money tied up. We have got to show turnover. It's like that driver spring for an 1800 that I sent back last week. It had been on hand eight months with none used. The stores department can't keep material on hand like that with no consumption."

"Yeah"—Evans fished in his pocket for his plug of horseshoe—"I used to keep material like that hid away, but can't do that any more. But we've got to keep locomotives running and seems to me that a few hundred dollars worth of material tied up is not as bad as several thousand dollars worth of locomotives."

"Mr. Evans," a machinist helper interrupted the conversation, "gimme an order for a driver spring for the 1841."

The foreman reached in his pocket for a pad of requisitions. The storekeeper stopped him. "We haven't got one. I just finished telling you that I sent the only one we had back."

Evans groaned. "Now what in the devil are we going to do. I've got to finish the 1841 to use on the branch line local tomorrow and we can't do it without a driver spring."

"If you had told me day before yesterday—"

"Yeah, if we always knew thirty days in advance what we were going to need and when we were going to need it, it wouldn't be any necessity for a storeroom. We could order material in advance and use it when it came in. Now we'll have to do one of two things, run the engine with a broken spring or use a bigger engine that we can't spare on the branch line local."

"Like I told you, we can't keep unused material on hand. I'd get in trouble if I did."

"And I get in trouble if you don't have it when I need it. When you going to get a set of tires for the 5061. Hers are worn past the limit and thinner than a boilermaker's alibi for laying off on pay day."

"Ought to be in by the last of the week," Foster replied, "and half a carload of brass, too." The storekeeper anticipated the next question.

"O.K., order a driver spring for the 1841 by wire. We haven't got anything to rob one off of," Evans flung over his shoulder as he left the storeroom.

The balance of the day went along about as usual. The foreman covered more miles than a mail carrier and answered more questions than a bureau of information. In between times he wrote requisitions for material, assumed responsibility for running locomotives with reported work undone and stayed one jump ahead of the despatcher on engine requirements. The latter was the greatest feat of all and accomplished only because of intimate knowledge of the condition of every engine. He even subconsciously took into consideration the engineer that would be pulling the throttle.

At four-thirty the 1846 had steam and ready to go. She was called to run at 7:00 p. m. The electrician climbed up in the cab and turned on the steam to the turbo generator. There was a rushing hissing sound of steam when Sparks opened the dynamo throttle instead of the siren-like crescendo wail of a normally operating turbine.

The electrician's first thought was that some one had removed the governor valve cap. He climbed out on top of the boiler to see. No, the valve cap was still there and tight. He opened the dynamo door. Armature and field coils were in place but the armature turned lightly when grasped by the commutator and given a twist.

The electrician climbed down and rushed to the electric shop for tools. He removed the head from the turbine. The wheel was entirely gone. Evidently it had been robbed at night or at some other time when he was not there. The head had been replaced and outside appearance gave no indication of the wheel being gone.

"Why didn't you tell me sooner?" Evans asked when Ned told him about the dynamo.

The electrician explained that he didn't know about it himself.

"Well, get one from the storeroom and put it on. More overtime!"

"But there isn't any in the storeroom. The dynamos on the 1800's are different from the others, older type."

Evans swore again. "We'll take one off the 1841. I'll have to figure on using some other engine on the branch line local."

At 6:30 all was peaceful and calm in the roundhouse. The house full of locomotives seemed deserted. The foreman's footsteps echoed loud on the cement runway as he walked through the house gathering up work reports preparatory to going home for the day. As he

walked he pondered. At least one-fourth of the time charged to repairs that day was because of not having the exact material available at the instant needed. Yet the storekeeper was following instructions.

Evans went to the office. He had finished washing and was ready to go when Bob Parker, the night foreman, came in.

"How's it going?" Parker asked.

"O.K., I guess," Evans replied. "See you in the morning at seven."

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Welding Studs to the Boiler

Q.—Is it permissible to weld studs to a locomotive boiler instead of tapping the sheets?

A.—The practice of welding studs to the boiler is permissible on the firebox wrapper sheet, back head and throat sheet, these sheets being supported by staybolts, also on the smokebox, which is not under pressure. The writer would not recommend the welding of studs to the shell of the boiler due to possible injury to the sheet which might be caused by lock-up and excessive localized stresses be set up in the shell by such welding.

Weight on Trailer Truck of Belpaire And Radially-Stayed Boilers

Q.—For a given boiler power, does the Belpaire or the radially-stayed boiler place the heaviest weight on the trailing truck? —K. F. G.

A.—This of course depends entirely upon the design of the boiler. More or less weight could be placed on the trailer truck of either of these types of boilers by shifting the center of gravity. A comparison of engines already built, having the same general dimensions, shows that the engines having the heaviest weights on the trailer trucks are those equipped with radially-stayed boilers.

Nickel Alloy versus Carbon Steel

Q.—What advantages, if any, has nickel alloy steel over carbon steel for use in locomotive boiler work?—B. A. D.

A.—In modern high pressure locomotive boilers higher elastic properties and strength are required than those of low carbon unalloyed steels. The strengthening of the steel at atmospheric and elevated temperatures by additions of nickel instead of by carbon increase has the following advantages:

The nickel steel has much greater ductility, toughness and resistance to shock. These qualities are essential in coping with service stresses in the usual riveted construction.

Nickel steels are stronger at elevated temperatures than carbon steels with corresponding carbon contents.

The nickel steels resist aging embrittlement, an undesirable effect encountered in carbon and some alloy steels as a result of the "cold-working" necessarily imposed in the customary operations of boiler construction.

Low carbon steels with about 2 per cent or more of nickel combine initially high toughness with a high degree of resistance to grain growth in recrystallization. They tend, therefore, to maintain their initially high toughness and are less sensitive to certain deteriorating influences in boiler construction technique than carbon steels.

Under some conditions the nickel steels will show better corrosion resistance than the carbon steels.

With the use of nickel steel, which has a high tensile strength, the weight of the boiler can be materially reduced or the boiler pressure can be raised without increasing the weight of the boiler.

Pneumatic Tool for Nuts, Caps and Plugs

A pneumatic-tool development by the Independent Pneumatic Tool Company, Chicago, combines the action of both a hammer and a wrench for removing and applying nuts, flexible-staybolt caps and washout plugs. This tool, called the No. 603 "Hamerench," operates horizontally to the nut or cap, and therefore can be used where working space is limited. In addition to the No. 603 "Hamerench" this company has developed a larger tool, designated as the No. 604 "Hamerench" for use on superheater units, 1¾-in. nuts and other heavy types of work.

The principle of operation employed in applying and removing nuts involves direct rapid hammer blows, delivered at right angles to the nut, which produces a rotating action for spinning the nut at high speed. The force of torque is not employed, so that there is not the dangerous shock to the operator that comes from using the torque principle.

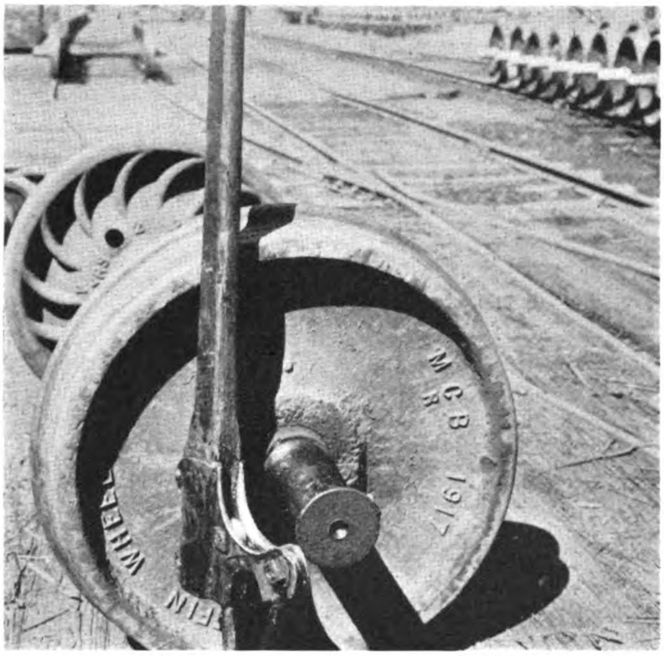
The "Hamerench" has been designed to remove and apply all sizes of nuts up to 1⅛-in. However, the tool can be furnished for larger sizes, such as flexible staybolts of all sizes, expansion-bolt caps, washout plugs, and similar applications. The "Hamerench" delivers 1,800 blows per min. and works in an 8-in. space. It is 22½-in. long overall, weighs 25 lb. and has a 1-in. square shank. Equipment supplied includes a hexagon chuck which is 1⅝-in. across the flat.

The Thor No. 603 Hamerench for removing and applying nuts, staybolt caps and washout plugs

With the Car Foremen and Inspectors

Ball-Bearing Wheel Stick

The ball-bearing wheel stick illustrated, has been used for some time on the Northern Pacific with very satisfactory results owing to its light but strong construction and the ease with which it permits car wheels to be turned at wheel shops and car repair points. An important feature of the design is the provision of two ball bearing rolls which support the wheels from the axle collar and thus avoid any possibility of scoring the journal as well as greatly reducing the frictional resistance to turning.



Partial view of wheel stick well worn but still as serviceable as when new

In the construction of this wheel stick two rolls are mounted on second-hand headlight ball bearings which are supported in a pair of pressed steel brackets, the top edges of which are rolled to assist in locating the axle collar without danger of contacting the journal or scoring the collar fillet. The wide ends of the brackets are separated and shaped to receive the tapered end of a substantial fir handle, which is held securely in place in the brackets by means of two 3/8-in. carriage bolts.

Supports for the roller bearing brackets is provided by two tapered 3/4-in. pipe sections, welded to one bracket only, and separated at the bottom by a short section of 1-in. pipe to which they are securely welded. This 1-in. pipe section, centrally located with respect to the wheel stick, serves as a guide for an adjustable 1-in. by 5 1/4-in. steel pin which provides a bearing point for the wheel stick and may be adjusted to one of three positions, dependent upon whether wheels are being turned on a hard shop floor or possibly at some outlying point on more or less loosely-packed earth where the wheel stick has a tendency to sink into the earth under the weight of the wheels.

This wheel stick has ample capacity for use in handling car wheels with axles up to 6 in. by 11 in.

Investigation of Wheel-Shop Practice*

By W. J. Fitzsimmons†

In the report of the Wheel Committee of the A.A.R. presented at Atlantic City this year, a paper was read tabulating defects causing removals on three different roads. It is expected that next year the committee will have considerably more data on this subject. Also, in several instances recently, attention has been called to defects occurring in early life of wheels placed under new equipment. Further, private-car lines are complaining of a large number of set-outs because of chilled-wheel removals for defects occurring long before ultimate life is reached.

The car-wheel manufacturers have, of course, recognized their portion of the blame, particularly for seams and worn-through chill, and are making every effort to eliminate these causes. On the other hand, even casual observation of chilled wheels under cars shows evidence in a good many instances of improper mounting practices.

In order to establish definitely just what the general practice was and to trace, if possible, the source of many so-called service defects, a recent check has been made of a number of shops in the Chicago area. A few of the larger shops were found to turn out excellent work, but a surprisingly large number were found to be breaking almost every rule of good shop practice. We have listed herewith the result of inspection of six shops taken at random, among which are represented car builders, private car owners and railroad shops. We have identified these shops by letters *A* to *F*, inclusive. We wish to particularly call attention to items which we feel would directly result in service defects.

It will be noted that all the shops listed bored wheels off center ranging from 3/32 in to 3/8 in. This condition in itself could well cause almost any defect but a seam or worn through chill. Throughout the life of the wheels, they would be subjected to uneven breaking, tending to cause slid flats, brake burns and shell outs. If they survived these defects, the constant pounding due to out-of-balance might well result in broken rims or even a broken wheel; also, inasmuch as both wheels on an axle would not necessarily be mounted out of center at the same point, the wheels would travel a zig-zag course, causing flange abra-

* Paper presented at a technical meeting of the Association of Manufacturers of Chilled Car Wheels, held at Chicago September 21 and 22.
† Service Engineer, Griffin Wheel Company, Chicago.

sion and strain resulting in a thin, vertical or even broken flange.

In addition to boring wheels off center, several of the shops listed bored them as much as ⅛ in. out of true with the flange. It would be few, indeed, of these wheels if they survive slid flats or brake burns in their early life, which would not be ultimately removed for flange defects.

The axle-lathe and wheel-press work were found to be equally bad. Wheel seats were either not burned at all or turned with a taper or out of round. Journals were turned with taper or rolled improperly. Wheel seats were guessed at, calipered or "miked" incorrectly. It cannot be otherwise than that a large number of wheels mounted with such practice would eventually be removed because of oil seepage, loose on axles or cut journals. It is little wonder that one of the shops checked had 150 truck sets sent back because of cut journals developing shortly after they went into service. Further, wheels mounted on axles or wheel seats out of true only aggravate conditions caused by wheels bored off center.

Undesirable Conditions Discovered in Six Car-Wheel Shops

Shop A

Boring Mills.—Wheels bored 3/32 in. off center; ⅛ in. out of true.

Axle Lathe.—Wheel seat turned with .004 in. to .009 in. taper. Journal turned .004 in. to .023 in. taper. Axles rolled in roll machine with bad centers; also bent spindle.

Wheel Press.—Recording gage and mounting gage in bad shape. Wheels spaced from back of flanges and checked with mounting gage.

Practice.—Wheel sticks used on journals for turning pair of wheels. Wheels bored same size were mounted on wheel seats varying .003 in. to .004 in.

Shop B

Boring Mills.—Wheels bored ¼ in. off center. Two tapers of .005 in. each, small in middle of hub and .004 in. out of round. Boring bar .015 in. loose in housing. Four of the five jaws holding wheel.

Axle Lathe.—Wheel seats turned with .013 in. taper small at dust-collar end and .004 in. out of round. Journals turned with .013 in. taper.

Wheel Press.—Ten tons' difference between indicating and recording gages. Wheels are spaced on axles with small piece of wood.

Practice.—Mike axles and caliper wheels. Wheels are fitted .012 in. to .014 in. tight.

Shop C

Boring Mills.—.001 to .003 in. taper large at front hub. 3/16 in. off center. Finish cut fed by hand. Finish cut did not go through hub. Three-jaw machine ⅛ in. out of true.

Axle Lathe.—.004 in taper. Small at dust collar end.

Wheel Press.—No recording gage used. Both wheels pressed on at one time. The wheels are gaged at one place only.

Practice.—Wheels fitted with calipers and tolerance estimated by holding calipers up to a light. Wheel seats are not turned.

Shop D

Boring Mills.—Three-jaw machine single cutter. One broken jaw welded crooked. Bores wheels ¼ in. off center. .003 in. taper large at back hub.

Axle Lathe.—Engine lathe used. 1/16 in. bent spindle. Bad centers. All axles turned run out of true from 1/16 in. to ⅛ in. .005 in. to .007 taper.

Wheel Press.—This machine has a 14-in. ram. Recording gage is for machine with a 9-in. ram and does not record correctly.

Practice.—Wheel fitted with calipers estimated .010 in. Actually .013 in. to .016 in. Mounted wheels are gaged at one place only. Wheel seats are not turned.

Shop E

Boring Mills.—⅛ in. out of center. .005 in. to .008 in. out of round. Taper from .003 in. to 018 in. Three-jaw machine, loose table, single-tool boring bar which is adjusted with hammer wedge. Boring-bar sleeve .020 in. loose in housing. Bores were small at the face hub.

Axle Lathe.—O. K.

Wheel Press.—Indicating gage but no recording gage.

Boring Mills.—Three-jaw machine single cutter. One wheel blocked up on two sawhorses to be pressed on.

Practice.—Wheels are fitted with calipers and are estimated to be .008 in. tight. Check with micrometers showed tolerance .013 in. to .016 in. tight. Wheel seats are not turned. Wheels counterbored ⅝ in. deep instead of ¼ in.

Shop F

Boring Mills.—Three-Jaw machine in bad shape. Single-tool boring bar. Tools don't fit bar; one side of tool does all the cutting. Tools improperly ground. Wheels bored ⅜ in. off center, ⅛ in. out of true with flange.

Axle Lathe.—Rollers have ⅛-in. fillet on one side and ¼-in. fillet on the other side.

Wheel Press.—Wheel press 3 in. low at one end, causing axles to spring 3/32 in. Twenty tons' difference between recording gage and indicating gage. Gages were last checked six years ago.

Practice.—Mounting gage worn ⅛ in. Journals not protected when pressing on. Wheels fitted with calipers held up to the light to estimate tolerance. Check with micrometer showed tolerance ranged from .006 in. to .023 in. Wheel seats are not turned. Wheels spaced on axle with small piece of wood from end of axle to back of hub.

Decisions of Arbitration Cases

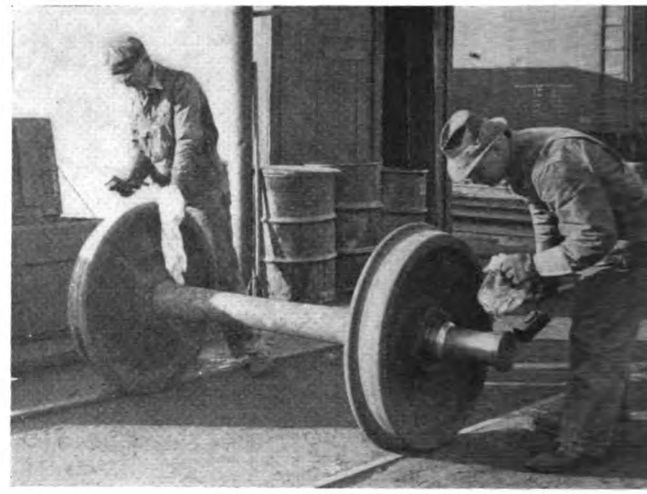
(The Arbitration Committee of the A.A.R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Repacking Journal Boxes Within Date

On November 19, 1934, the Seaboard Air Line repacked all the journal boxes on a Southern car three days before the expiration of the time limit, to the charges for which the Southern took exception. The Seaboard, while admitting the work was performed prior to the expiration of the time limit, declined to withdraw the charge, stating that in another case it had been required to accept a charge from the Virginian for cleaning air

brakes one day before the expiration of the time limit. The Southern contended that in the case of the Seaboard Air Line versus the Virginian the Arbitration Committee only suggested that the Seaboard accept the charge and that this was not done to establish a precedent to perform such service two, three, four or any number of days before the time limit expires.

The Arbitration Committee stated in a decision rendered November 12, 1936, that "The principle of Decision 1748 applies. The contention of car owner is sustained."—*Case No. 1751, Southern versus Seaboard Air Line.*

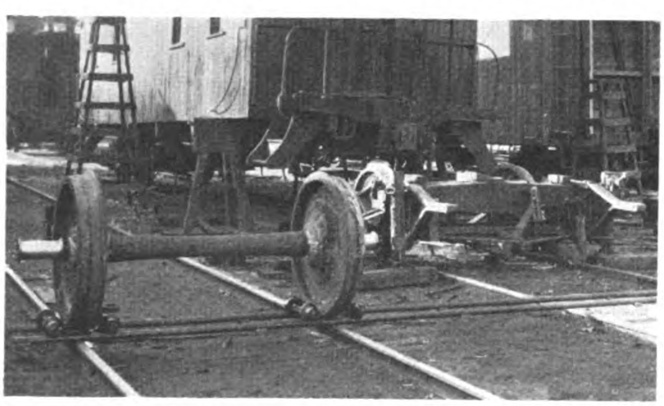


Method of cleaning rust-preventive coatings from car axle journals using distillated and fiber brushes

Wheel-Handling Device

An unusually simple and satisfactory device for handling car wheels from standard-gage material supply tracks to all repair tracks in freight-car-repair yards and shops, is shown in one of the illustrations. The principal advantage of the device is that it permits easily sliding a pair of wheels lengthwise from one track to the other, with slight manual labor and without the necessity of turning the wheels with a wheel stick, rolling them to the other track and returning them, all of which involves quite heavy manual labor and possible marring of the journal with the wheel stick. An additional important advantage is the facility with which a pair of wheels may be slid under a loaded car in the train yard or elsewhere with minimum jacking and small space between cars. The particular wheel-handling device shown in the illustration is used at the Danville, Ill., freight-car-repair yard of the Chicago & Eastern Illinois, and similar devices are used at five other points on this railroad, where freight-car maintenance is carried on.

Referring to the illustration, the general construction



Wheel-handling device used at car repair points on the Chicago & Eastern Illinois

of the device will be readily apparent. It consists simply of two lengths of 1¼-in. extra-heavy pipe, spaced on 11-in. centers and held in a fixed position by welded cross straps made of ¾-in. by 2-in. iron. The pipe-section track is 17 ft. 6 in. long, but when necessary to extend the pipe sections over two or more tracks an additional section of 17-ft. 6-in. track can be readily joined to the first by means of dowel-and-pin connections. Two dollies are furnished with each track section, each consisting of a welded steel framework designed to support the weight of the car wheels and operating on four flanged dolly wheels which roll on the pipe tracks. Each dolly framework is low-hung so that the car wheels have to be raised only about 2¾ in. on tapered oak wedges to roll from the standard-gage track to the dollies. Transverse movement of the wheels to the other repair track is then accomplished with considerable ease.

The second illustration shows the operation of cleaning car wheel journals as they pass the oil house to the material-delivery track at the Danville shops. Protective material on the journals is removed by the use of distillate and a fiber brush, as shown in the illustration. Viscosity axle coating grease No. 5 is used for the most part in protecting the journals against corrosion and this material is readily removed by use of the distillate mentioned.

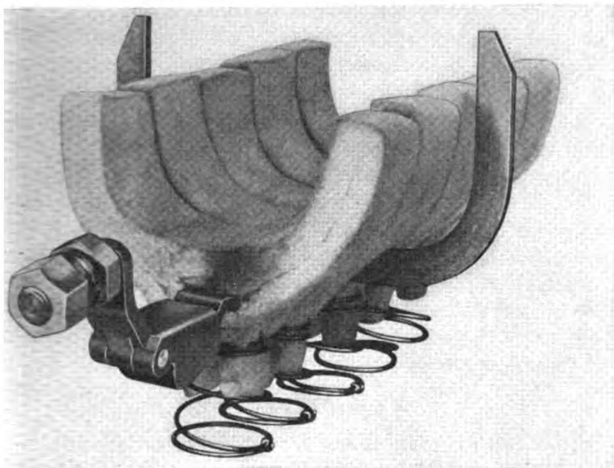
Miller Felpax Lubricator

A journal lubricator incorporating multiple-wool sections, designed for use in conventional journal boxes of diners, baggage cars, other passenger train cars or tenders, has recently been developed and placed on the market by the Miller Felpax Company, Winona, Minn. Road service tests of this lubricator have been conducted during the past 18 months or more with successful results under unusually severe winter conditions. The lubricator is also said to be well adapted for service on equipment operating through desert country where high temperatures and dust storm conditions are encountered.

The multiple wool sections of the lubricator, as shown in the illustrations, are shaped to fit the underside of the journal against which they are held by spring pressure from the bottom of the journal box. Two small semi-circular spring steel wires, imbedded in each wool section, assure the maintenance of full contact with the underside of the journal. The sections are interlocked in a simple manner and bolted to the front of the journal box, as illustrated, to prevent shifting. A U-iron, fitting between two of the sections, further prevents rotative movement. The lubricator sections are made of high-grade virgin wool so shaped that the end fibers are in contact with the journal, thus tending to prevent glazing and providing maximum capillary action. Four lubricator sections are required on 5-in. by 9-in. journals and five on all larger sizes up to 6½ in. by 12 in.

The Miller Felpax lubricator can be easily applied to

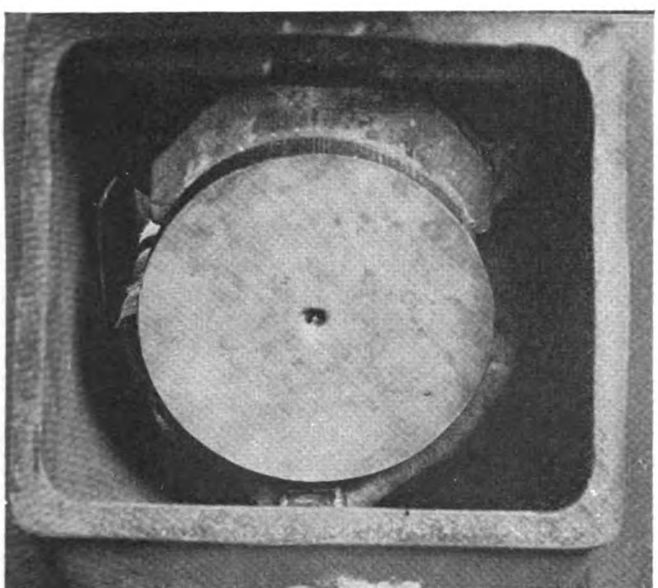
or removed from any standard journal box without jacking. No special tools or skilled help are required in the application which cannot be made incorrectly. Ordinary car oil is used as a lubricant, being applied in



Miller Felpax car-journal lubricator ready for application

the journal box to a maximum depth of about 1 in. Experience in the road service tests mentioned indicate that the lubricator operates without glazing or noticeable wear and with a journal temperature appreciably lower than with waste-packed boxes.

Additional advantages claimed are complete lubrication over the entire brass, minimum bearing wear, elimi-



Miller Felpax lubricator applied in a standard journal box

nation of waste grabs and glazing, reduced oil consumption, minimum inspection and attention enroute. Moreover the lubricator need not be removed for examination except at the time of wheel change. Rebrassing is done without touching the lubricator. If desired, the lubricator can be removed sectionally in a few minutes. Repacking during the winter due to soggy packing is eliminated.

In routine winter servicing, snow at the lid of the journal box is removed in the usual manner, however, some snow and ice remaining in the bottom of the journal box is said not to affect the lubricator. A small amount of car oil is added to the box about once weekly, for the best results. It is said that tests conducted last winter showed no need for additional servicing of passenger-car journals equipped with this lubricator, even in the case of 36-hr. lay-overs with the thermometer at numerous times registering 20 deg. below zero.

Selecting Satisfactory Freight Cars for Commodity Loading*

The selection of cars for commodity lading is of vast importance, and great responsibility lies on the shoulders of car men in so far as the condition of car as to mechanical conditions, construction and cleanliness is concerned. Traffic conditions have changed so rapidly and demands made by the traffic departments and public that it becomes necessary for the successful operation in the proper organizing and systematic planning of the work. This requires close co-operation between car, transportation, operating and traffic departments; constant supervision over empty cars; proper and prompt mechanical inspection and commodity classification; proper utilization; prevention of cross-hauling of equipment.

During the past ten years or more, there has been a decided change in the attitude of shippers as to cars furnished for their lading. Demands are now made for first class cars, clean cars, etc., and in addition there is more and more demand for cars of some specific dimensions, either as to width, height, or length, single sheathed or double sheathed, wooden roof or metal roof, or completely wood lined, etc., which condition meets shippers' requirements. This naturally requires close co-operation between car department forces and operating and transportation department forces. When certain cars, such as "order cars" are required for connecting line or home line industrial lading, car forces should be given information by operating department forces (yardmaster or car order clerk), so proper inspection can be made and cars properly classified for such particular loading. This then protects each department, avoids dissatisfied shippers, unnecessary switching and expense.

Classification of Cars

In the classification of house cars, in order properly to take care of this work it should be done during daylight hours under blue flag protection. For some years, the matter of uniform inspection and reclassification has been a live subject. It does not seem that much progress has been made. It appears doubtful, but hopeful, if a real uniform inspection can be accomplished; the principal reasons are the views or peculiarities of the shippers in different sections of the country and the fast growing demands made by shippers for various types of equipment, difference of opinion by the shippers as well as car inspectors and car men. What may be an entirely acceptable flour car in the Twin City area may be unsatisfactory at Chicago, Buffalo or Kansas City. This same condition holds true of other classes of equipment. Some times it is difficult for an inspector on one railroad to commodity classify a car in a way that would be ac-

* Abstract of a paper presented by F. J. Swanson, general car department supervisor, Chicago, Milwaukee, St. Paul & Pacific, Minneapolis, before the regular monthly meeting of the Car Foremen's Association, of Chicago, held at the Hotel LaSalle, Chicago, September 13, 1937.

ceptable on another railroad, because of not knowing the peculiar local conditions at the loading point.

Flour cars, as we all know must be clean, free from protruding nails, bolt heads, have good floors and end and side walls, door posts, as well as door post nailers flush with side lining to prevent damage to contents. Cars must have good roofs and tight sides to prevent any damage due to water or cinders. Good judgment can be used in the classification of such cars.

Some times we feel that our job is quite difficult, but we must not become discouraged. We must feel that there is no problem in the railroad field that cannot be worked out to the satisfaction of all concerned; therefore, we should continue to strive toward adopting standards as far as practicable that would tend toward a more uniform inspection and re-classification.

On November 24, 1931, A.A.R. circular letter No. D. 11-348 was issued by the Transportation division of the A.A.R. which covers "Recommended Practice For Standard Inspection and a Uniform Inspection Card."

This recommended practice has been in effect for some six years, yet I doubt very much if the recommendation has had its effect. Most railroads employ their own classification or commodity cards, as well as instructions. The particular inspection card as shown on page 4 of circular letter D. 11-348, does not now comply with the A.A.R. Rule 36 Supplement Number 2, due to red printing. Furthermore, that card does not bring out the objective. If a car is found unfit for certain lading, this card cannot be used. The car must either be marked for the repair track or the cleaning track for reconditioning.

As station agents, where no car men are employed, are used and held responsible for loading out of their stations, they make their own inspections and re-classification. This card would not be practical if such cars were found requiring reconditioning. If the reverse side or back of these cards distinguished that such cars required reconditioning, the cars would go on through to the first repair or cleaning point for reconditioning, which makes for more prompt, proper and economical handling of equipment, eliminates considerable empty back-haul of equipment and gives the superintendent of transportation a true check of equipment as classified on the various divisions and side tracks.

The C. M. St. P. & P. is employing a system of inspection and application of commodity cars which I feel is very practical and efficient. We have a set of instructions covering inspection of cars for various lading, similar to circular D. 11-348, but our commodity cars are somewhat different. We employ the use of five cards, namely: (a) Car fit for loading flour, cereal, paper, sugar, and empty tin cans; (b) Car fit for loading bulk grain; (c) Car fit for loading cement; (d) Car fit for dressed lumber, sash and doors, furniture, hay, sheet steel, tin plate, canned goods, crated and boxed goods and general merchandise; and (e) Car fit for loading coal, hides, ties, oil, paint, grease, brick, tile, machinery, greased rods and shafting, scrap iron, scrap rags, scrap paper, rough lumber, tar, vinegar and similar rough freight commodities.

On the reverse side or back of cards bearing letters "A," "B," "C" and "D," we have added the letter "X" behind the letters mentioned. For illustration, if a flour car carded "A" is found unfit for flour loading, the "A" card which shows "AX" on reverse side, is applied, which signifies that this car is unfit for such loading until reconditioned. The transportation department sends this car to the nearest cleaning or repair tracks. In my opinion, the inspection or commodity card as shown in circular D. 11-348, could be improved upon for more economical handling of equipment and re-classification.

Sweating of Cars

Much has been said during the past few years as to interior sweating of cars, or condensation in box cars. A complete study was made by members of the A.A.R. Car Construction Committee, with the co-operation of Freight Claims division, Freight Containers bureau and the director of research of the Mechanical division. Four test house cars, steel sheathed, fully wood-lined, were assigned for this test and specially fitted up and equipped with observation windows, internal lighting, observation trap doors in side and end lining and roof lining used, as well as thermometers for temperature readings. The conclusion of this committee was that a special type of car is not established or justified. The proceedings of Division V, Mechanical Division, 1933 to 1935, inclusive, pages 139 to 142, inclusive, bring out the facts of the test.

Cleaning of Cars

For a good many years, all have been confronted with the question of cleaning house cars for higher class lading account floors, side and end walls being covered with oil and grease spots; also cars contaminated with a "green hide smell."

In the case of box cars, previously loaded with grease or oil commodities, if the floors and inside walls are thoroughly saturated, there is not much that can be done to recondition such cars for flour or other high-class lading. The top surface of oil can be removed by the use of steam and hot water and a solution of soda ash and lye, but there still remains some oil inside the wood which will syphon up when hot lading is loaded in the car. However, we have been quite successful on cars partly covered or spotted by using hot water sprayed under steam pressure and saturating oil spots with this soda ash solution.

The matter of box cars contaminated with green hide odors has been quite a problem for the past few years; however, some railroads are having success by use of spray washing and deodorizing operations. The material used is a solution known as "Freight Car Cleaner" which serves as a cleaner as well as a disinfectant. A certain amount is added to the hot water, which is thoroughly mixed and put on the car floor and inside walls of car. Two or three operations may be necessary to remove the hide odors as well as stains from car, making it possible to place the car in high-class loading.

In order to eliminate this unnecessary condition and expense, when cars are ordered for this class of lading, car forces, as well as station agent forces must make positive that rough freight cars or cars assigned for this lading be furnished. Continuous washing of inside walls and floors of house cars causes deterioration, increased freight car maintenance, shortens life of car, and causes empty mile hauling of equipment and switching expense, also delay to equipment. Much can be done to improve on these conditions.

Some railroads employ the use of floor sanders and planers for smoothing rough floors and lining which has been found practical, saving expense of removing rough lumber which would be necessary in order to use such cars for flour, paper and other high-class lading.

Wood-Patch is also being applied successfully to floors and inside walls of house cars. This material is applied similar to putty, dries hard, becomes a part of the object to which applied, does not shrink or expand, sheds water and stops all leakages; also, will not absorb odors. Appears to be very practical. Various floor sealers are also employed for covering over oil spots.

In conclusion I want to emphasize the important part the car man or supervisor plays who has charge and is responsible for classifying cars for commodity loading.

Naturally, the transportation department, as well as the operating department depends entirely on the commodity card which he has placed on the empty equipment, taking into consideration the necessity for making a positive inspection to the interior of car, with a view of developing whether it contains any protruding nails, spikes, bolts, rough floors and side walls, oil spots or other defects in the floor or siding liable to cause damage in the way of damage to its contents. It is also very important when applying this commodity card that the car itself is physically fit as far as the running gear, etc., is concerned, as delays mean quite an expense in freight claim payments.

During the year 1936 a total of approximately $21,000,000 was paid by the railroads for loss and damage. Claims due to train accidents increased 36.7 per cent. Those due to defective or unfit equipment 30.6 per cent. Those due to delay, 28.8 per cent.

Improper application of commodity cards when switched to an industry for loading some times after moving several hundred miles across country to get this particular loading, inspection discloses it is unfit for this particular commodity. This you appreciate causes a dissatisfied shipper, unnecessary cross haul of equipment and possible loss of business.

The proper selection of cars for commodity lading is highly essential. Conditions are changing so rapidly that car men must educate themselves to become acquainted and accustomed to the various classes of lading that cars are required to handle.

Informal Discussion Of Car Questions

In the November issue of the *Railway Mechanical Engineer* was published the informal discussion of car questions raised at the May meeting of the Northwest Carmen's Association. The discussions of some additional questions raised at this meeting are given below; they are not authoritative answers to the various points raised, but simply are the views of the association regarding a few of the many important questions which confront car men. Some questions, submitted in writing after the May meeting, were answered by the association's A.A.R. committee.

Question.—Occasionally cars are received from connecting lines with bad-order cards still attached. The only notation on the bad-order card is "Repack" or "Reweigh." One car, on which such cards were recently found, and removed, showed the car carded bad order and, opposite the word "Defect," "Repack" had been written in. The card was dated March 5, 1937, and the old repack date shown as November 7, 1935. Rule 66 provides for periodic repacking of journal boxes after the expiration of 15 months. As the date of the last repacking on the car referred to was not 16 months old, does it not appear that the repairing line was a little technical?

Answer.—The inspector was perfectly within his rights to card the car for repacking after the expiration of 15 months.

Question.—Effective April 1, 1937, cars defined as Class E-4, under Rule 112, will not be accepted from owners. In the event a Class E-4 car is offered in interchange, in otherwise good condition, what attitude should be taken by the receiving line?

Answer.—All roads in the Twin Cities have gone on record to the effect that such cars will not be accepted in interchange for line movement.

Question.—The Safety Appliance Laws require a minimum of 4 in. clearance on sides and back of handbrake wheels, and the A.A.R. Loading Rules require a minimum of 6 in. clearance at the same location. Why would it not be practical to adopt a clearance dimension that would be the same with both bodies.

Answer.—Safety Appliance Laws cover minimum requirements for safety; loading rules specify 6 in. in order to provide easier access for men to work.

Question.—To what extent is an originating carrier responsible for clearance for loads to destination, even though it acts as a switch line only?

Answer.—The originating line is responsible if it is the delivering line, even though it acts merely as a switching line.

Question.—Rule 107, Item 126 carries a labor charge of 0.2 hr. for removing and repairing coupler release levers, all types, one or two sections, whole or in part, including the pivot bolt in the Carmer type; exclusive of brackets or supports and their fastenings.

Rule 108, Item at top of page 216 excludes a charge for the connector between the handle section of the release lever and the knuckle lock lifter, J, S, Carmer, or similar types R. R. & R.

Does this prohibit a charge for the inside section of the Carmer lever where the same is removed, repaired and replaced?

Answer.—A charge is permissible.

Question.—Is sheathing split or broken behind a door on a refrigerator car a cardable defect?

Answer.—If merely caused by striking of door fixtures it would not be cardable, but if caused by any Rule 32 condition it would be cardable.

Question.—Do question and answer No. 9 or Rule 32 also apply to body bolsters?

Answer.—Yes.

Question.—Can anything be done on cars with AB brakes blowing through retainer besides cutting car out or changing triple?

Answer.—Blowing at the retaining valve when a car is equipped with AB brakes may be caused by one of several conditions.

In release position it may be caused by service slide-valve leakage, emergency slide-valve leakage, or ruptured diaphragm and timing-valve leakage.

In service and emergency position, it may be caused by service slide-valve leakage, release-insuring-valve leakage, or service-portion gasket leakage.

These defects can be distinguished only on a test rack.

The rules require that these valves (when found defective) should be sent to a repair point and no attempt made to repair them in the yard.

Question.—Rules 58 and 59, page 104. Can pipe and pipe fittings and connections be charged against owners on cars from which such items are missing as stated in these rules? A.A.R. Rules 58 and 59 give no information regarding charging of pipe and pipe fittings.

Answer.—A charge can be made against car owner. See Interpretation 2, Rule 58.

Question.—Rule 4, Sec. (b) reads: "Defect cards shall not be required for slight damage (new or old) which does not require repairs."

Why are defect cards being issued for damage that does not require repairs, such as sheathing on refrigerator cars that is raked only into the bottom of the bead? The cars remain in service year after year with the same old defects and are not repaired, and the de-

fect cards covering such defects become dirty and worn out and are not readable.

Answer.—Rule 4 specifies the extent of damage to be carded. Effort is being made to have this rule changed on refrigerator sheathing.

Question.—(a) What is the out-of-round wheel? (b) Is an out-of-round wheel necessarily worn through chill? (c) Is the gage used to condemn an out-of-round wheel the same that was formerly used to condemn worn through chill spots? (d) How is a worn through chill spot indentified?

Answer.—(a) A wheel out of round 1/16 in in a radius of 12 in., determined by gauge. (b) No. (c) Yes. (d) Wheel and Axle Manual recommends drawing a straight edge over the trend of wheel and if there is a pronounced bowing out at the rim the wheel is worn through chill.

Question.—Is a brake beam missing in fair usage a delivering line defect for which a defect card should be issued?

Answer.—Cars should not be offered in interchange with brake beam missing. No defect card should be issued.

Questions and Answers On the AB Brake

Operation of the Equipment (Continued)

222—*Q.—What change in the port connections are now made by the emergency slide valve?* A.—Connection is cut off between the emergency reservoir and the accelerated release piston chamber and established between the latter and the quick-action chamber.

223—*Q.—What is the effect of this connection?* A.—As the quick-action-chamber air is now acting on both faces of the accelerated release piston, putting it in balance, the 20 lb. differential causes the emergency piston to move to the extreme left, compressing the emergency piston return spring and moving the accelerated release piston to its extreme left-hand position.

224—*Q.—The emergency piston is now in what position?* A.—In accelerated release position.

225—*Q.—Up to this time has any movement of the service piston occurred?* A.—No.

226—*Q.—Why?* A.—Sufficient release differential has not been established across the face of the service piston to bring about any change.

227—*Q.—How is the emergency reservoir connected at this time?* A.—Movement of the emergency slide valve blanks the emergency reservoir port in the seat, bottling up this volume.

228—*Q.—How long does this condition exist?* A.—Until the service slide valve moves to release and connects the auxiliary- and emergency-reservoir pressures.

229—*Q.—In this position what communications are established in order to accelerate the release, and also the build up of the brake-pipe pressure?* A.—The brake cylinder is connected to the brake pipe via the inshot valve, passages to cavity *K* in the emergency slide valve, and passage leading to the accelerated emergency release checks.

230—*Q.—Does this affect the auxiliary reservoir pressure?* A.—Yes. The brake cylinder and auxiliary reservoir are connected by the service slide valve and the pressure of these combined volumes is greater than that of the brake pipe.

231—*Q.—What results from this?* A.—The combined auxiliary and brake-cylinder pressures underneath the emergency release check valves, being greater than the pressure in the brake pipe above the check, cause the checks to unseat, permitting the air under the combined pressures to flow into the brake pipe.

232—*Q.—How long does this flow continue?* A.—Until the pressures are within about 10 lb. of equalization.

Portable Spray-Painting Equipment

The DeVilbiss Company, Toledo, Ohio, has recently developed and placed on the market a new spray-painting outfit especially designed for painting the rougher types of railroad equipment, such as box cars, gondolas, hoppers, tank cars, passenger car underframes and trucks, and baggage car interiors where application of a maximum volume of paint in a minimum amount of time is required.

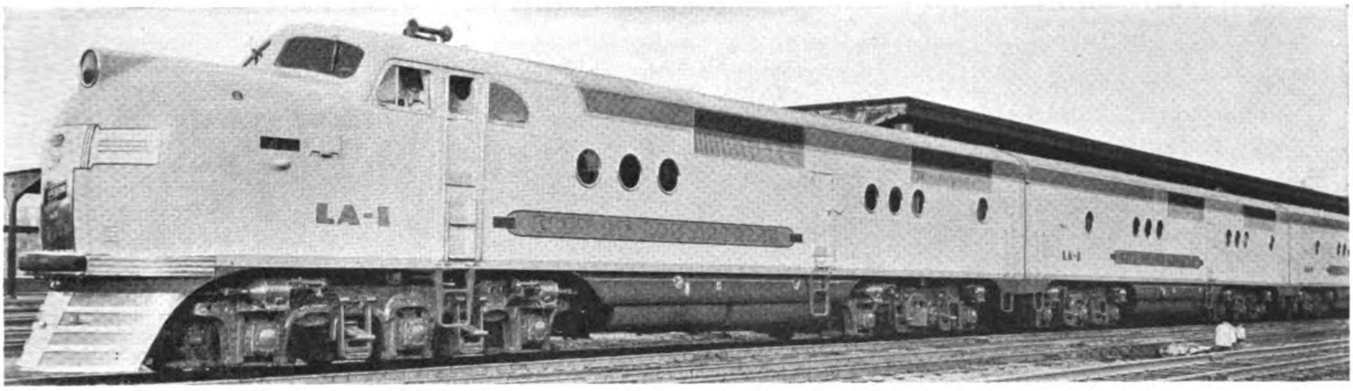
DeVilbiss Type QA-601 portable spray-painting outfit

The outfit consists of an extension gun, a 15-gal. tank, a 50-ft. length of ½-in. fluid hose and a two-wheel truck to provide easy portability. The spray gun is the single hose type, having an internal mix spray head. It is available with 3-ft. or 6-ft. extension.

The gun is furnished with two caps. No. 1 gives a fairly wide spray up to 16 in., while No. 2 delivers a narrower spray, 18 in., at somewhat greater velocity. Both caps will handle one quart of heavy box car paint per minute, producing a well atomized and even spray.

The mixing head atomizes the paint in the tank prior to its delivery to the gun where it is finally atomized by the spray head. The mixing head is equipped with air regulator, fluid shut-off valve, and adjusting valve.

The tank is equipped with a hand-operated agitator with which paint requiring agitation may be kept in proper state of suspension.



5,400-hp. Diesel locomotive recently delivered to the Union Pacific by the Electro-Motive Corporation

NEWS

C. & E. I. Coach Shop Destroyed by Fire

FIRE of undetermined origin completely destroyed the 125-ft. coach shop of the Chicago & Eastern Illinois at Danville, Ill., on November 22. The loss will total several hundred thousand dollars, since the building valued at $100,000 was completely destroyed, and machinery and tools and five coaches undergoing repairs were damaged.

Tank Car Head Block Anchorage Date Extended

IN a letter to all tank car owners, Secretary V. R. Hawthorne, A.A.R. Mechanical Division, calls attention to Interchange Rule 3, Sec. (t), Par. (8), in the 1937 Code, which provides that, effective January 1, 1938, tank cars having head block anchorage will be prohibited in interchange. Several requests for an extension of the above effective date were considered at a recent meeting of the Arbitration Committee, which approved a one-year extension in the effective date of this requirement, with the proviso that no further extension beyond January 1, 1939, will be granted. This action has been approved by the general committee.

A.A.R. Research on Axles

A COMPREHENSIVE program of research to determine what further improvements can be made in the methods of manufacturing axles used on locomotives and cars is being conducted by the Division of Engineering Research of the Association of American Railroads, according to a recent announcement from A.A.R. President J. J. Pelley. The tests, which began early in November, Mr. Pelley said, are designed to bring about "still greater safety and economy on the railroads of this country."

Steel axles, the statement points out, range from approximately 5½ in. in diameter, the size used on freight and passenger cars, to approximately 14 in., the size to which the massive driving wheels on modern locomotives are attached. The research work is being conducted on especially constructed testing machines which have been built at the Timken Roller Bearing Company plant at Canton, Ohio, and are under the direction of a committee of mechanical officers from the various railroads and axle manufacturers co-operating with L. W. Wallace, director of the Division of Engineering Research.

The first test deals with axles used on passenger cars, and when that has been completed a study of axles used on freight cars will be made. After that the test will include the various sizes of axles used on locomotives and locomotive tenders.

In order to test the strength and durability of the various sizes of axles, "gigantic" machines have been built at the Timken Roller Bearing plant which will rotate a full size axle at varying speeds while at the same time stresses will be placed on it at various locations to determine the number of revolutions that can be made before an axle actually breaks.

In order that complete knowledge can be obtained as to the various kinds of railroad axles now in use, several hundred axles of varying sizes are being put through every possible test. These axles have been obtained directly from the manufacturers and a complete detailed history of each one has been prepared from the time the ore was first received at the mill until the axle finally emerged from the

New Equipment Orders and Inquiries Announced Since the Closing of the October Issue

LOCOMOTIVE ORDERS

Company	No. of locos.	Type of loco.	Builder
C. B. & Q.	5		Company shops
Reading	2*	900-hp. Diesel switch.	American Locomotive Co.
	6*	600-hp. Diesel switch.	Electro-Motive Corp.

LOCOMOTIVE INQUIRIES

C. M. St. P. & P.	2†	Hiawatha	....
	5†	4-6-4	....
South Manchuria Railway	25-100	2-8-2	....

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Barrett Company	15	6,000-gal. Tank	Gen. Am. Tank Car Corp.
C. B. & Q.	600	Box	Company shops
	100	Hopper	Company shops
	400	Coal	Company shops
D. M. & I. R.	25	Ore	Pullman-Std. Car Mfg. Co.
L. C. L. Corp.	240	Air-activated containers	American Car & Foundry Co.
Northwestern Refrig. Line Co.	250	Refrigerator	American Car & Foundry Co.
St. Louis-San Francisco	6	70-ton Coal	American Car & Foundry Co.

FREIGHT-CAR INQUIRIES

D. L. & W.	500	50-ton Hopper	....
Louisiana & Arkansas	100-300	Pulpwood	....
U. S. Navy Dept.	1	50-ton Hopper	....

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
C. B. & Q.	3‡	Dining	Edw. G. Budd Mfg. Co.
	5‡	Chair	Edw. G. Budd Mfg. Co.
	3‡	40-seat Dinette	Edw. G. Budd Mfg. Co.
New York Central	2§	Coaches	Edw. G. Budd Mfg. Co.

* To cost approximately $600,000.

† Prices sought preparatory to seeking authority of district court to secure additional motive power.

‡ To be of lightweight stainless steel construction—three dining cars and three chair cars for the "Aristocrat," two 40-seat dinette coaches for the Denver "Zephyr," one 40-seat dinette-coach for the original "Zephyr" and two chair cars to be used jointly by the Colorado & Southern and the Fort Worth & Denver City.

§ To be of lightweight construction.

steel mill as a properly rounded piece of steel 7½ ft. long and ready for the wheels to be attached.

Mechanical Division Letter Ballot Results

THE results of the 1937 letter ballot of the A.A.R. Mechanical Division have just been made available in circular No. DV-927, recently issued by the secretary's office. The recommendations for changes in the standard practice of the division, made by various committees at the June meeting at Atlantic City, N. J., were divided into a total of 113 propositions as follows: Arbitration Committee, 1 proposition; Brakes and Brake Equipment, 10 propositions; Car Construction, 6 propositions; Couplers with Draft Gears, 3 propositions; Air Conditioning and Equipment Lighting, 1 proposition; Locomotive Construction, 3 propositions; Specifications for Materials, 17 propositions; Tank Cars, 2 propositions; Wheels, 8 propositions; Loading Rules, 62 propositions.

As a result of a favorable letter ballot all of these propositions, from Nos. 1 to 113, inclusive, to amend the standard and recommended practice of the Division are approved. The propositions among the foregoing to amend the Interchange Rules and Loading Rules of the Division become effective January 1, 1938, with the exception of modifications already issued in Supplement No. 1 of the loading rules which became effective September 1, 1937. Propositions Nos. 13, 14 and 42, covering Definitions and Designating Letters, become effective immediately. All others become effective March 1, 1938.

Diesel Plan Book and Engine Catalog—A Correction

THE price of the Diesel Plan Book and Engine Catalog by John W. Anderson, described on page 533 of the November, 1937 issue of the *Railway Mechanical Engineer*, is incorrectly given as $2. The book costs $3.

Improvement Program

The Norfolk & Western's program of general improvements for the immediate future involves an expenditure of about $200,000 for shop tools, also the purchase of 4,000 sets of improved (AB) air brakes for application to freight cars.

The Western Pacific plans to ask for bids some time after January 1 for the work of constructing a new locomotive erecting and machine shop with two 125-ton locomotive lifting cranes and a new boiler plant at its general locomotive repair shops at Sacramento, Cal. This work will involve an expenditure of approximately $360,000.

The Atchison, Topeka & Santa Fe is engaged in enlarging its passenger engine and coach terminal at Chicago. As a part of this program, it has acquired approximately three acres of ground extending 240 ft. on Wentworth avenue and 560 ft. on Archer avenue. The facilities that will be constructed as a part of this enlargement program include a shop for servicing high-speed Diesel-electric engines and air-conditioning equipment, which will be 300 ft. long and 65 ft. wide; a two-story service building of approximately the same dimensions; and a single-story building 400 ft. by 30 ft. in plan. The latter two structures will accommodate such activities as carpet cleaning, the servicing of Pullman cars, painting, the repair of generators and batteries, and will contain storage facilities and locker rooms. The plans also contemplate the construction of a new power house, enlargement of the enginehouse and turntable, the construction of an enlarged yard for cleaning and servicing passenger equipment and the construction of additional storage tracks. A depressed pit 1,200 ft. long, for use in inspecting high speed trains, will also be constructed. Contracts have already been awarded for the grading for track changes, for the power house and for the enlargement of the enginehouse.

Riveted Aluminum Alloy Tank Cars

THE Interstate Commerce Commission, by Commissioner McManamy to whom the matter was assigned, has issued an order granting applications of the War Depart-

(*Continued on next left-hand page*)

* * *

One of the coaches of a glass train built at Doncaster, England

A train, almost completely of glass, except for the roof, has been built by Messrs. Pikkington Bros., Doncaster and is now touring England and Scotland. Blue mirrored Vitroflex—small squares of "unbreakable" glass—covers the coaches. Inside are glass floors, glass pictures, and a bathroom lined with Vitrolite and armored plate glass which bends without breaking. Two hundred varieties of glass are used in the train.

ment and the Gulf Oil Company, respectively, for authority to construct and operate in experimental rail service 25 and five tank cars with riveted aluminum alloy tanks for the transportation of gasoline. The order in No. 3666, In the Matter of Regulations for Transportation of Explosives and Other Dangerous Articles, points out that the applications were "unanimously recommended by the Tank Car Committee and concurred in by the Bureau of Explosives, Association of American Railroads."

The cars will be constructed in accordance with shipping container specification 103AL, which is embodied in the order, including A. A. R. requirements reproduced as an appendix to the specification.

Armco Dedicates Unique Laboratory

A NEW structure of novel design, which was built at Middletown, Ohio, to house the research laboratory of the American Rolling Mill Company, was dedicated on November 5 with more than 200 scientists from all parts of the country participating in the ceremony. At a banquet in the evening, which concluded the day's activities, the dedicatory address was made by Charles F. Kettering, vice-president in charge of research of the General Motors Corporation. Addresses were also presented by George M. Verity, chairman of the board of the Armco Rolling Mill Company, and by Charles R. Hook, president. Dr. Anson W. Hayes, Armco's director of research, was toastmaster.

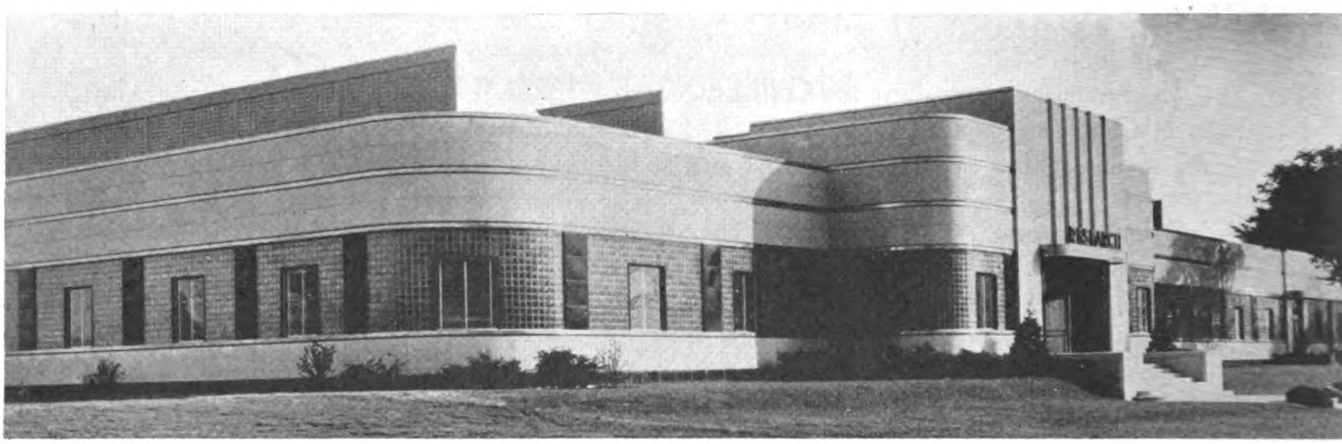
The new single-story research building, which cost $280,000, embodies many products which were developed by the company's research organization. It represents the first use, on a large scale, of sheet metal in building construction. The building has a frontage of 250 ft. and a depth of 175 ft., providing 43,500 sq. ft. of floor space. It has a saw-tooth roof and the entire frame is of welded-steel construction with not a rivet driven in the structure.

Three of the exterior elevations are faced with combinations of porcelain-enameled iron sheets, stainless steel and glass block. The skeleton for the outside walls is formed of square metal tubing with similar tubing placed horizontally beneath the window sills and above the glass-block panels. All of the wall tubing is welded to the structural frame. In all sections, except at the glass-block openings, 20-gage galvanized panels, with flanges facing inward, are bolted to the framework and furnish the exterior wall covering. The interior walls of the laboratory section are covered with 22-gage flat-steel sheets painted in two tones of gray.

The rear wall, saw-tooth gables and most of the partitions in the laboratory section are of special insulated steel construction. The wall is formed with two thicknesses of light-gage sheet steel filled with a special mineral product similar to mica which possesses high sound-proofing and insulating qualities.

Ventilation and atmospheric conditions are controlled by two-air conditioning systems, one for the laboratory staff offices and one for the test shops and laboratory. Deep-well water is used for summer cooling.

There are 12 laboratories with complete facilities for specialized research. They include equipment for the testing of steel in process; welding methods with flat rolled materials; forged-steel car wheels; stainless steel; development of corrosion-resistant sheets and strip; iron strips for porcelain enameling; high-finished sheets for deep drawing; sheets for electrical uses; development of zinc and other metal coatings for sheets; development of non-metallic coatings and the improvement of surfaces to hold these coatings; blast-furnace, open-hearth and electric-furnace experiments.



Porcelain enamel, stainless steel and glass block form the exterior of the new research laboratories of The American Rolling Mill Company, Middletown, Ohio

Arch Bar Date Extended

IN a letter to all car owners signed by J. M. Symes, vice-president, A.A.R. Operations and Maintenance Department, attention is called to an extension of the date when cars with arch-bar trucks will not be accepted in interchange from car owners. The Board of Directors of the association considered this matter and a number of applications for extension of its effective date at a meeting held at Chicago on Thursday, November 18, 1937. The board has directed that the effective date of this rule be extended until July 1, 1938; with the further provision that, after April 1, 1938, mileage or per diem shall not be paid car owners for cars equipped with arch bar trucks.

Supply Trade Notes

CARY D. TERRELL, vice-president of the American Car and Foundry Company, with headquarters at Chicago, will resign on January 1, because of ill health.

J. H. VAN MOSS has been appointed western sales manager of the American Car and Foundry Company, with headquarters at Chicago, and W. P. McBride will be assistant western sales manager.

SAMUEL F. PRYOR, JR., has been appointed assistant to the president of the American Brake Shoe & Foundry Company. Mr. Pryor is also vice-president of the Southern Wheel Division of the company, with headquarters at New York.

FRANK FISHER has been appointed western manager of The Pilliod Company, with headquarters at Chicago.

THE RAILWAY TRUCK CORPORATION, 80 E. Jackson boulevard, Chicago, has been organized to manufacture and sell bolster friction springs and truck stabilizing devices for freight cars. Officers and incorporators of the new company are W. W. Rosser, president; J. F. Ryan, vice-president; and A. C. Davidson, chief engineer.

(Turn to next left-hand page)

L. W. WALLACE, director of engineering research of the Association of American Railroads, has resigned to become director of engineering and research of the Crane Company, Chicago. This newly created division of the Crane Company comprises the existing division of research and development and the product engineering department and has been formed to coordinate all engineering activities and further progress in diversified fields. Mr. Wallace will be directly responsible to the president and under his supervision the

L. W. Wallace

division will conduct the necessary research and engineering to develop present and new products. A sketch of Mr. Wallace's career appeared in the September *Railway Mechanical Engineer,* page 423.

United States Steel Corp. Appointments

BENJAMIN F. FAIRLESS, president of the Carnegie-Illinois Steel Corporation, has been elected to succeed William A. Irvin as president of the United States Steel Corporation as of January 1, 1938, Mr. Irvin being elected vice-chairman of the board, effective January 1. Myron C. Taylor confirmed to the board his intention, as previously stated to them, not to accept re-election as chairman of the board of directors at the time of its annual meeting, April 4, 1938. Mr. Taylor will thereafter maintain his present office at 71 Broadway, New York, and will continue as a member of the board and of the finance committee. It is planned that Edward R. Stettinius, Jr., present chairman of the finance committee, shall succeed Mr. Taylor as chairman of the board on April 5 next; and that Enders M. Voorhees, now vice-chairman of the finance committee, shall then assume the chairmanship of that committee. J. L. Perry, now president of the Tennessee Coal, Iron & Railroad Co., will, on January 1, 1938, succeed Mr. Fairless as president of the Carnegie-Illinois Steel Corporation, and Robert Gregg, vice-president of the United States Steel Corporation, will become president of the Tennessee Coal, Iron & Railroad Co., as of January 1. The resignation of Thomas Morrison of Pittsburgh as a director of the corporation was accepted and Mr. Fairless was elected to fill the vacancy.

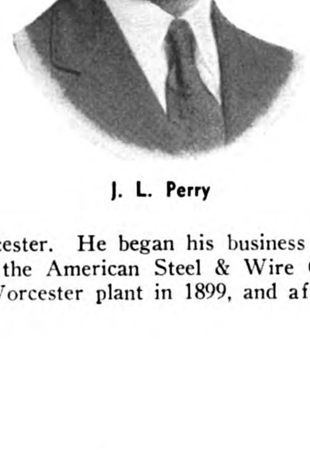
Benjamin F. Fairless, who was born at Pigeon Run, Ohio, on May 3, 1890, is a graduate in civil engineering of Ohio Northern University which, a few years ago conferred upon him the honorary degree of doctor of engineering. For two

(c) Bachrach

B. F. Fairless

years Mr. Fairless was a teacher and, for a few months, a civil engineer for the Wheeling & Lake Erie. In August, 1913, he became a civil engineer for the Central Steel Company of Massillon, later becoming, in turn, mill superintendent, general superintendent, and vice-president in charge of operations. When the United Alloy Steel Corporation and Central merged in September, 1926, Mr. Fairless was appointed vice-president and general manager of the United Alloy Steel, and in April, 1928, became president and general manager of the company. When this company, in April, 1930, was one of several united in the formation of the Republic Steel Corporation, Mr. Fairless went into the new organization as executive vice-president. When the newly created Carnegie-Illinois Steel Corporation was formed in the autumn of 1935 from the Carnegie Steel Company and the Illinois Steel Company, both units of the United States Steel community of companies, Mr. Fairless was made president.

J. L. Perry was born at Worcester, Mass., on March 11, 1881, and was educated in the grade and high schools of



J. L. Perry

Worcester. He began his business career with the American Steel & Wire Co., in its Worcester plant in 1899, and after occupying various positions became manager of the Worcester district of this company in 1928. On January 1, 1933, he was elected to the vice-presidency of the American Steel & Wire Co., in charge of operations, with headquarters at Cleveland, Ohio, and in February, 1935, was elected president of the Tennessee Coal, Iron & Railroad Co., of Birmingham, Alabama.

Robert Gregg, formerly president of the Tennessee Coal, Iron & Railroad Co., was appointed vice-president in charge of sales of the United States Steel Corporation on February 1, 1935. Mr. Gregg is 52 years of age and a native of Atlanta, Ga. He

Blank & Stoller

Robert Gregg

was educated in the Atlanta public schools, Georgia School of Technology, and was graduated from Cornell University. He began his business career in August, 1907, with the Atlanta Steel Company of Georgia, continuing with that company and its successor, the Atlanta Steel Company, until August 1, 1932. He then resigned to accept the vice-presidency of the Tennessee Coal, Iron & Railroad Co., and in October, 1933, became president of that company.

Simmons-Boardman Elects Two Vice-Presidents

ROBERT E. THAYER and H. A. MORRISON of the Simmons-Boardman Publishing Corporation have been elected vice-presidents of the corporation. Mr. Thayer is New England manager of the Railway Age and business manager of the *Railway Mechanical Engineer,* with headquarters at New York, and Mr. Morrison is western manager of Railway Age and business manager of Railway Signaling at Chicago.

Robert E. Thayer was born at Chelsea, Mass., on August 4, 1883. He is a graduate of the Massachusetts Institute of Technology, from which he obtained the degree of Bachelor of Science in Mechanical Engineering in 1907. Immediately upon leaving the Institute he accepted a position with the American Locomotive Company as a special apprentice. In 1908 he became an instructor in mechanical engineering at his Alma Mater, M.I.T. During 1910 he served as a draftsman in the mechanical department of the Boston & Maine at Bos-

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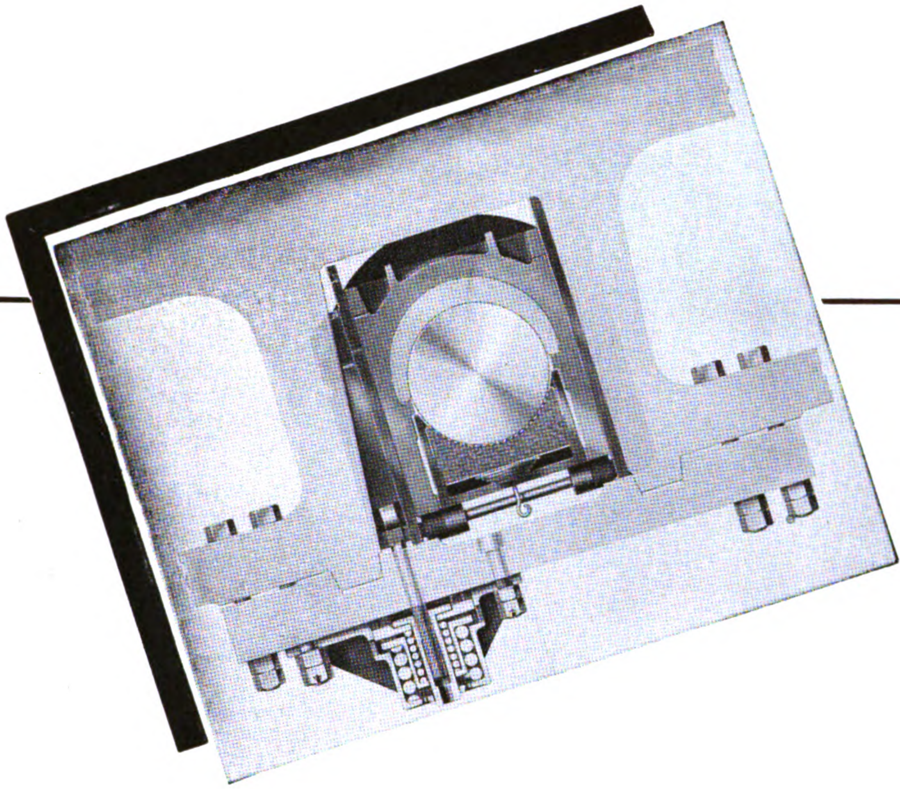
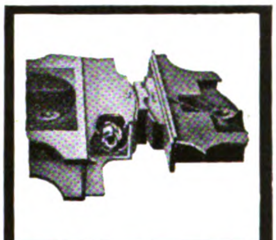
LOOSE, STUCK, OR FITTED?



Because of driving box expansion due to temperature changes in driving boxes as the locomotive hauls its train, hand adjusted driving box wedges cannot be accurately fitted — they are either too loose or too tight. Driving box temperature varies more than 250 degrees in short spaces of time. » » » The Franklin Automatic Compensator and Snubber automatically compensates for driving box expansion and maintains accurate driving box fit at all times. It also compensates for wear and provides a spring-held snubbing resistance that cushions unusual shocks. » » » This also maintains correct alignment of the machinery parts and makes an easier riding locomotive. » » » Its twin, the Type E-2 Radial Buffer, maintains correct relationship of engine and tender and reduces oscillation between these units. Together, they increase safety, improve riding comfort and reduce locomotive and track maintenance.



Franklin Type E-2 Radial Buffer dampens oscillation between engine and tender and makes for easier riding.

No locomotive device is better than the replacement part used for maintenance.
Genuine Franklin repair parts assure accuracy of fit and reliability of performance.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

ton, Mass. During the following year he entered the service of the Simmons-Boardman Publishing Corporation, becoming an associate editor on the staff of the Railway Age Gazette (now the Railway Age). In

R. E. Thayer

January, 1917, he became mechanical department editor of the Railway Age and, at the same time, managing editor of the *Railway Mechanical Engineer.* In 1919 he was appointed European editor of the Railway Age and associated Simmons-Boardman publications, with headquarters at London, England. Early in 1922 he returned to the United States as New England advertising manager of all Simmons-Boardman transportation publications and, in June, 1929, became also business manager of the *Railway Mechanical Engineer* and, later, business manager of the Car Builders' and Locomotive Cyclopedias. He continues to retain these responsibilities in his capacity as vice-president. Mr. Thayer has been a member of the American Society of Mechanical Engineers since 1919.

H. A. Morrison was born on December 21, 1892, at Indianapolis, Ind., and studied electrical engineering at Purdue University. In 1912 he entered the traffic department of the Pennsylvania at Indianapolis, where he remained until 1915, when he became a special apprentice in the electrical department of the Chicago, Rock Island & Pacific at Silvis, Ill. In June, 1918, he was transferred to the office of the general mechanical superintendent at Chicago. On September 1, 1919, he resigned to become sales engineer of the United States Light & Heat Corp., Chicago, becoming district manager of the railway sales department on May 1, 1924. On May 1, 1925, Mr. Morrison resigned to enter the service of the Simmons-Boardman Publishing Corporation as sales representative at Chicago. On July 1, 1930, he was appointed business manager of Railway Signaling, a Simmons-Boardman publication, and on August 2, 1932, became western manager in charge of sales in the western

H. A. Morrison

territory for all transportation publications of the company, at the same time continuing as business manager of Railway Signaling. In the capacity of vice-president, Mr. Morrison will retain the responsibilities of both these positions.

Obituary

Frederick W. Brill, for many years assistant treasurer of the J. G. Brill Company, Philadelphia, Pa., died in the Jefferson hospital, Philadelphia, on October 23. Starting in 1896, in the engineering department, Mr. Brill was transferred to the sales department in 1906, making his headquarters at St. Louis, Mo.

Homer D. Williams, former president of the Carnegie Steel Company and later of the Pittsburgh Steel Company, died on November 13, in the University of Maryland Hospital, Baltimore, Md., at the age of 74 years. Mr. Williams had served 56 years in the steel industry at the time of his retirement in February, 1936.

James B. Armstrong, secretary and treasurer of the Flannery Bolt Company, Bridgeville, Pa., died on November 6, following an emergency operation for appendicitis. For a number of years, Mr. Armstrong was associated with the Crucible Steel Company of America and the Brown Iron Company before his association with the Flannery Bolt Company.

Charles C. Cluff, who retired in 1932, after serving as New York sales manager of the Carnegie Steel Company, the Illinois Steel Company and the Tennessee Coal, Iron & Railroad Company, died on November 13, at his home in New York, at the age of 74 years. Mr. Cluff had been in the steel industry for about 50 years, until his retirement in 1932. He was the last of the three original incorporators of the United States Steel Corporation.

Clarence M. Burnett, vice-president of the Lewis Bolt & Nut Co., Minneapolis, Minn., and one of the founders of the company, died at his home in St. Paul on October 31. Mr. Burnett was born on December 31, 1883, at Chippewa Falls, Wis. After attending public schools at Bethel, Vt., he was graduated from Norwich College, Northfield, Vt. Mr. Burnett was for many years in the steel business at Bethlehem, Pa. Shortly before the World War he went to Minneapolis, where he was connected with the Twin City Forge & Foundry Co. After serving eight years as sales manager for Paper Calmenson & Co., he aided in the formation of the Lewis Bolt & Nut Co.

Personal Mention

General

F. B. Barclay, superintendent of motive power of the Illinois Central at Chicago, has retired.

J. F. Jennings, superintendent of equipment of the Michigan Central, with headquarters at Detroit, Mich., has had his jurisdiction extended to include the West division of the M.C.

Joseph Chidley, superintendent of equipment of the New York Central, West of Buffalo, and the Ohio Central Lines, with headquarters at Cleveland, Ohio, has had his jurisdiction extended to include the Western division of the N.Y.C.

E. M. Wilcox, superintendent of equipment for the New York Central System, at Chicago, has been appointed assistant superintendent of equipment with the same headquarters, and the position of superintendent of equipment has been abolished.

A. B. Childs has been appointed acting mechanical engineer of the Northern Pacific, with headquarters at St. Paul, Minn., to succeed G. F. Endicott, who has been granted a leave of absence.

F. S. Robbins, superintendent motive power of the Atlantic Coast Line, has been appointed general superintendent motive power, with headquarters as before at Wilmington, N. C., succeeding James Paul, who retired on November 1. A photograph of Mr. Robbins and a biographical sketch of his railway career were published in the November issue of the *Railway Mechanical Engineer,* in connection with his appointment as superintendent motive power.

G. C. Christy, superintendent of the car department of the Illinois Central at Chicago, has been appointed superintendent of motive power, succeeding F. B. Barclay.

Willard J. Dann has been appointed mechanical inspector of the Chicago, Burlington & Quincy, with headquarters at Chicago, to succeed Louis G. Kunzer, who has retired from active service after having been in the employ of this company 40 years.

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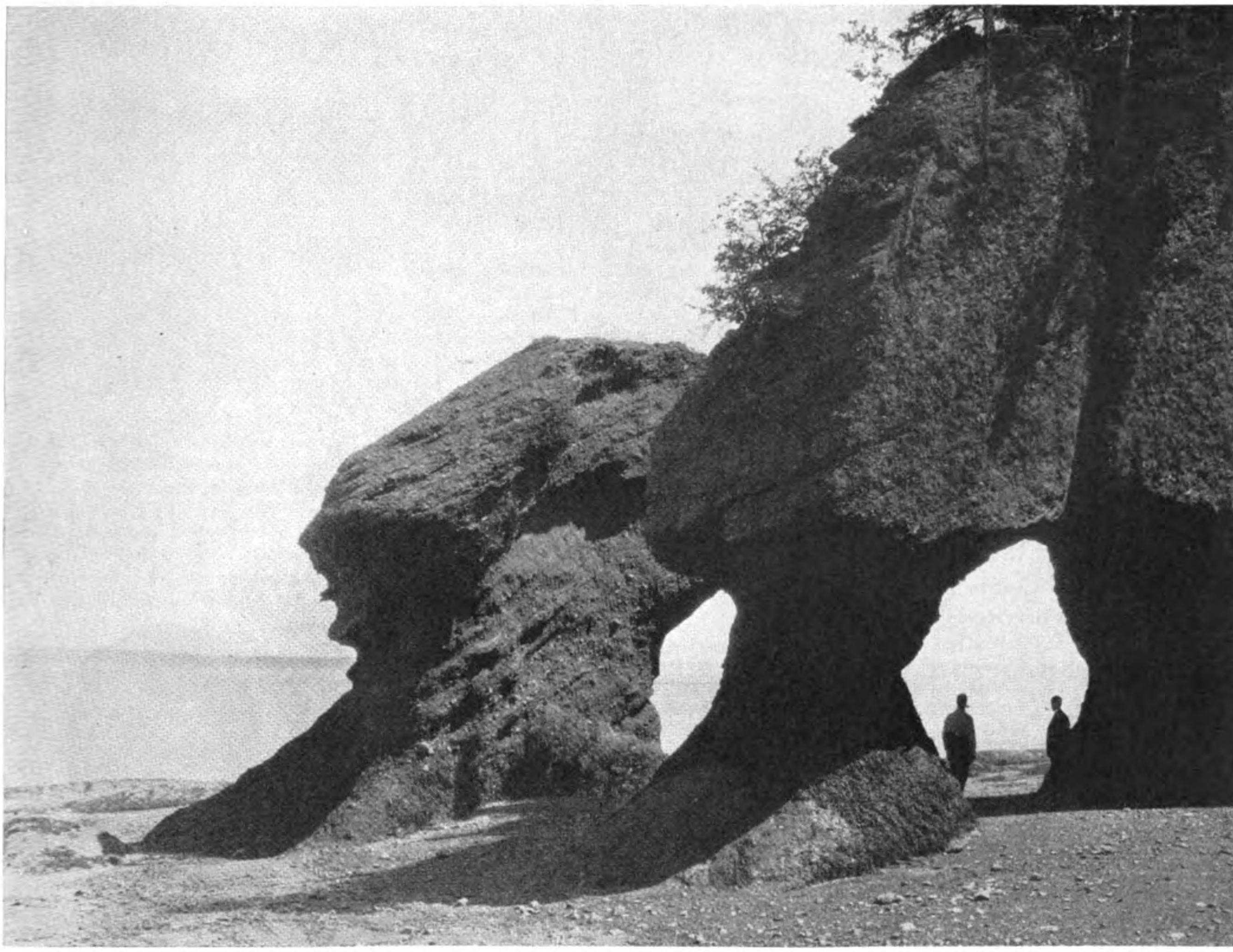
NO. 9 OF A SERIES OF FAMOUS ARCHES OF THE WORLD



HOPEWELL ROCKS

PETITCODIAC RIVER, NEW BRUNSWICK

Tides of the Bay of Fundy, between New Brunswick and Nova Scotia, do strange things to the Canadian landscape—much to the delight of the tourists. For one thing, they rush up the Petitcodiac River with tremendous force and create the famous Bore . . . A wall of water from three to six feet high (it depends on the season) drives along until it reaches the bend in the river opposite Moncton. There the two-direction river is half a mile wide and the incoming flood makes a waterway capable of floating large vessels . . . Fundy tides create the Hopewell Rocks, too, with their strange shapes and their many high arches. Erosion is one of the most fantastic of sculptors . . . The Rocks are at Hopewell Cape, about twenty miles from the city of Moncton, N. B. . . . Moncton, the transportation centre of Canada's Maritime Provinces, is headquarters of the Atlantic Region of the Canadian National Railways.

* * *

The Security Sectional Arch for the locomotive firebox improves fuel economy on any locomotive. It has had a major influence in firebox design of large modern power and is essential to their successful operation.

HARBISON-WALKER REFRACTORIES CO.

Refractory Specialists

AMERICAN ARCH CO.
INCORPORATED

Locomotive Combustion Specialists » » »

JOSEPH A. DEPPE, assistant superintendent of the car department, has been appointed superintendent of the car department, with headquarters also as before at Milwaukee, to succeed K. F. Nystrom.

KARL F. NYSTROM, superintendent of the car department of the Chicago, Milwaukee, St. Paul & Pacific, has been appointed mechanical assistant to the chief operating officer, with headquarters as before at Milwaukee, Wis.

OTTO JABELMANN, assistant general superintendent of motive power and machinery of the Union Pacific, with headquarters at Omaha, Neb., has been appointed to the newly-created position of assistant to the president in charge of research.

LEE ROBINSON, assistant to the general superintendent of motive power of the Illinois Central at Chicago, has been appointed superintendent of equipment, following a change in the title of F. R. Mays from general superintendent of motive power to general superintendent of equipment.

Master Mechanics and Road Foremen

J. H. PAINTER, master mechanic of the Atlantic Coast Line at Florence, S. C., has retired.

HOWARD P. PERRY has been appointed master mechanic of the Lehigh & Hudson River, succeeding Fred Jackson, deceased.

K. A. CRAIG has been appointed traveling locomotive inspector of the Kansas City Southern, with headquarters at Pittsburgh, Kan. Mr. Craig's jurisdiction will extend over the entire line.

R. J. MACNAMARA, assistant trainmaster of the Monongahela division of the Pennsylvania, with headquarters at Pittsburgh, Pa., has been appointed acting road foreman of engines of the Wilkes-Barre division, with headquarters at Sunbury, Pa.

GEORGE B. ECKER, road foreman of engines, in charge of the entire Cincinnati Terminal of the Baltimore & Ohio, with headquarters at Cincinnati, Ohio, has been appointed road foreman of engines, with headquarters at Washington, D. C.

W. J. WISENBAUGH has been appointed road foreman of engines of the Cincinnati sub-division of the Ohio division, and Louisville sub-division of the St. Louis division of the Baltimore & Ohio, with headquarters at Cincinnati, Ohio.

V. N. STAHLEY, road foreman of engines of the Chicago Great Western, has been appointed general road foreman of engines with headquarters at Oelwein, Iowa, to succeed T. Olson, who was appointed master mechanic several months ago.

OSCAR G. PIERSON, general foreman of the Atchison, Topeka & Santa Fe, at Arkansas City, Kan., has been promoted to the position of master mechanic of the Oklahoma and Southern Kansas divisions, with headquarters at Arkansas City, to succeed John K. Nimmo, retired.

W. G. WILSON has been appointed master mechanic of the Illinois and Missouri divisions and the DuPo terminals of the St. Louis Terminal division of the Missouri-Pacific and of the Missouri-Illinois Railroad (a subsidiary of the Missouri Pacific), with headquarters at DuPo, Ill., to succeed W. C. Smith, who has retired.

CHARLES D. SMITH, who has been appointed master mechanic of the Port Arthur Division of the Canadian National, with headquarters at Sioux Lookout, Ont., as noted in the November issue of the *Railway Mechanical Engineer*, was born on February 23, 1888, at Creemore, Ont. He attended public and high schools and entered the service of the Canadian Pacific in October, 1904, as a machinist apprentice at North Bay, Ont. From May, 1906, until May, 1907, he was a fireman on the Temiskaming & Northern Ontario at North Bay. He then became a fireman on the Canadian National, and in March, 1908, an engineman. He was in passenger service on the Canadian National out of Edmonton, Alta., from 1911 until his appointment as master mechanic at Sioux Lookout.

Purchasing and Stores

E. A. RUSSELL, district storekeeper of the Canadian National at Saskatoon, Sask., has been transferred to Edmonton, Alta.

J. B. FRASER, storekeeper of the Canadian National at Point St. Charles, Montreal, has been appointed district storekeeper at Saskatoon, Sask.

C. S. ARGYLE, district storekeeper of the Canadian National at Transcona, Man., has been appointed assistant general storekeeper at Winnipeg, Man.

W. C. HOWARD, chief clerk of the Canadian National at Montreal, has been appointed storekeeper at Point St. Charles, succeeding J. B. Fraser.

W. L. OSWALT, assistant works storekeeper of the Pennsylvania, with headquarters at Altoona, Pa., has been appointed works storekeeper, succeeding O. V. Daniels, deceased.

J. C. MCCAUGHAN, general foreman of stores of the Chesapeake & Ohio, at Huntington, W. Va., has been appointed district storekeeper, with headquarters at Richmond, Va.

B. A. CUMBEA, division storekeeper of the Chesapeake & Ohio at Clifton Forge, Va., has been appointed general foreman of stores at Huntington, W. Va.

C. S. JONES, district material supervisor of the Southern Pacific at West Oakland, Calif., has been appointed division storekeeper, with headquarters at Portland, Ore., to succeed J. F. McAuley, deceased.

S. A. HAYDEN, general storekeeper of the Missouri-Kansas-Texas, with headquarters at Parsons, Kan., has been promoted to assistant purchasing agent and general storekeeper, with headquarters at St. Louis, Mo.

J. B. NOYES, general storekeeper of the Minneapolis, St. Paul & Sault Ste. Marie, has been appointed assistant purchasing agent and general storekeeper, with offices at Shoreham (Minneapolis), Minn.

G. W. LEIGH, purchasing agent of the Minneapolis, St. Paul & Sault Ste. Marie, the Duluth, South Shore & Atlantic and the Mineral Range, has been appointed purchasing agent and general storekeeper of these roads, with offices at Shoreham (Minneapolis), Minn.

Car Department

J. F. MONGER, general foreman of the car department of the Illinois Central at Chicago, has been appointed car shop superintendent at Chicago, succeeding J. M. Brophy.

J. M. BROPHY, car shop superintendent of the Illinois Central at Chicago, has been appointed superintendent of the car department, with headquarters at Chicago. Mr. Brophy has been in the service of this company for more than 24 years. During the early years of this period he served as a car-repair inspector, air-brake inspector and assistant foreman at Ft. Dodge, Iowa,

J. M. Brophy

and Waterloo. In June, 1916, he was transferred to Paducah, Ky. From August, 1917, to March, 1919, he was in the service of the United States Army, returning to the Illinois Central after the war as an inspector, serving at Paducah and Owensboro, Ky. In May, 1921, Mr. Brophy was appointed coach foreman at Louisville, Ky., and in December, 1928, became general car foreman at the same point. After a year in the latter capacity he was assigned to a similar position at the Burnside shops, Chicago, where he served until March, 1934, when he was appointed car shop superintendent.

Shop and Enginehouse

J. MCALLISTER, supervisor shop machinery and tools of the New York Central at West Albany, N. Y., has retired.

Obituary

J. J. MAGINN, superintendent of motive power of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio, died on November 13.

VOL. 111 No. 12

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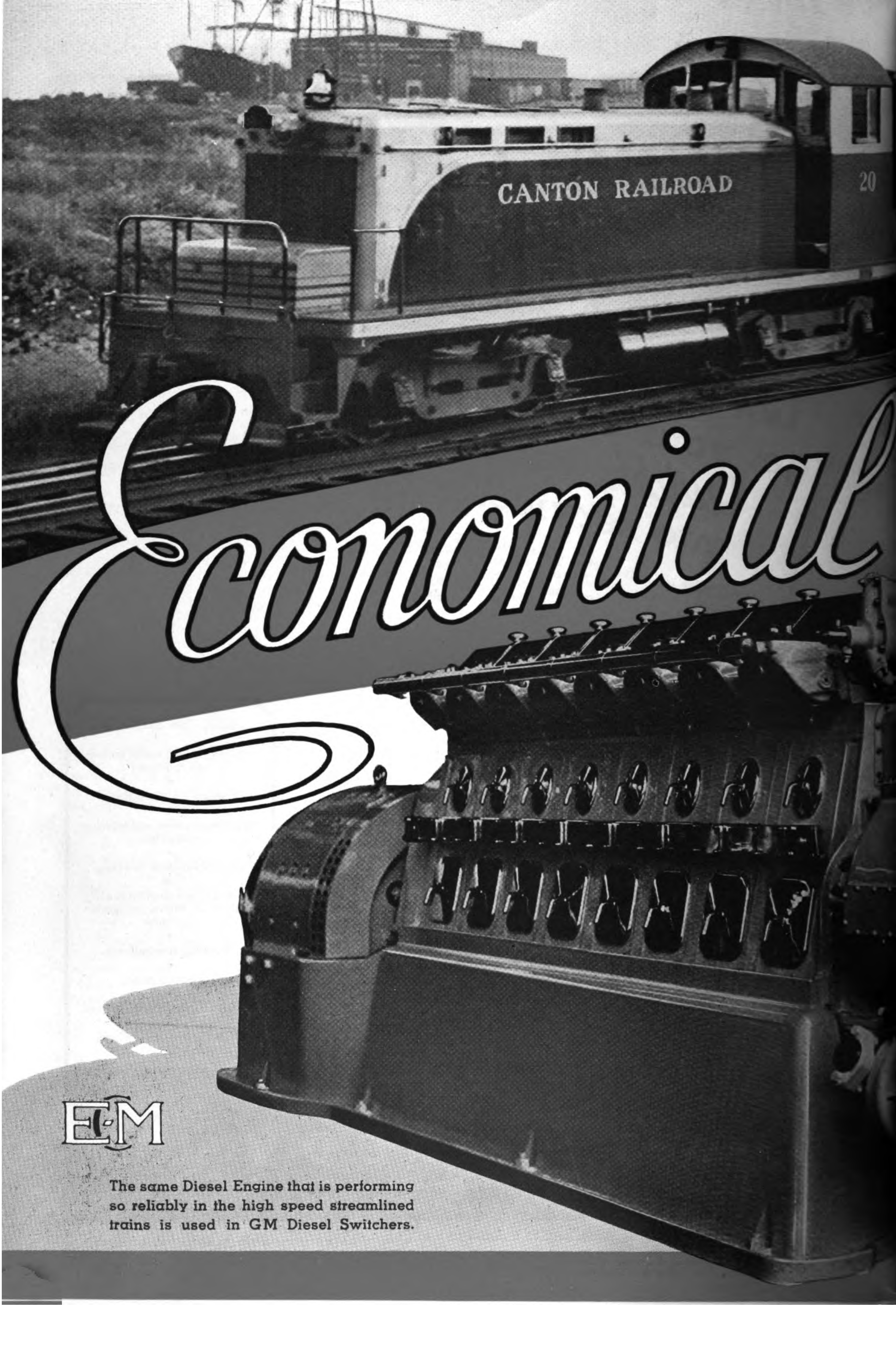
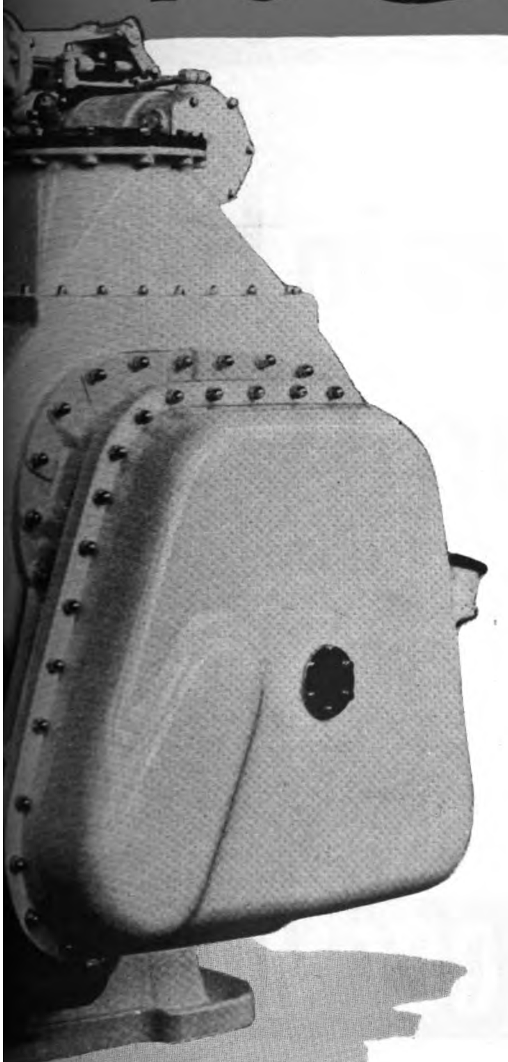

CANTON RAILROAD
20
Economical
E-M
The same Diesel Engine that is performing so reliably in the high speed streamlined trains is used in GM Diesel Switchers.

—To Operate —To Maintain —To Service



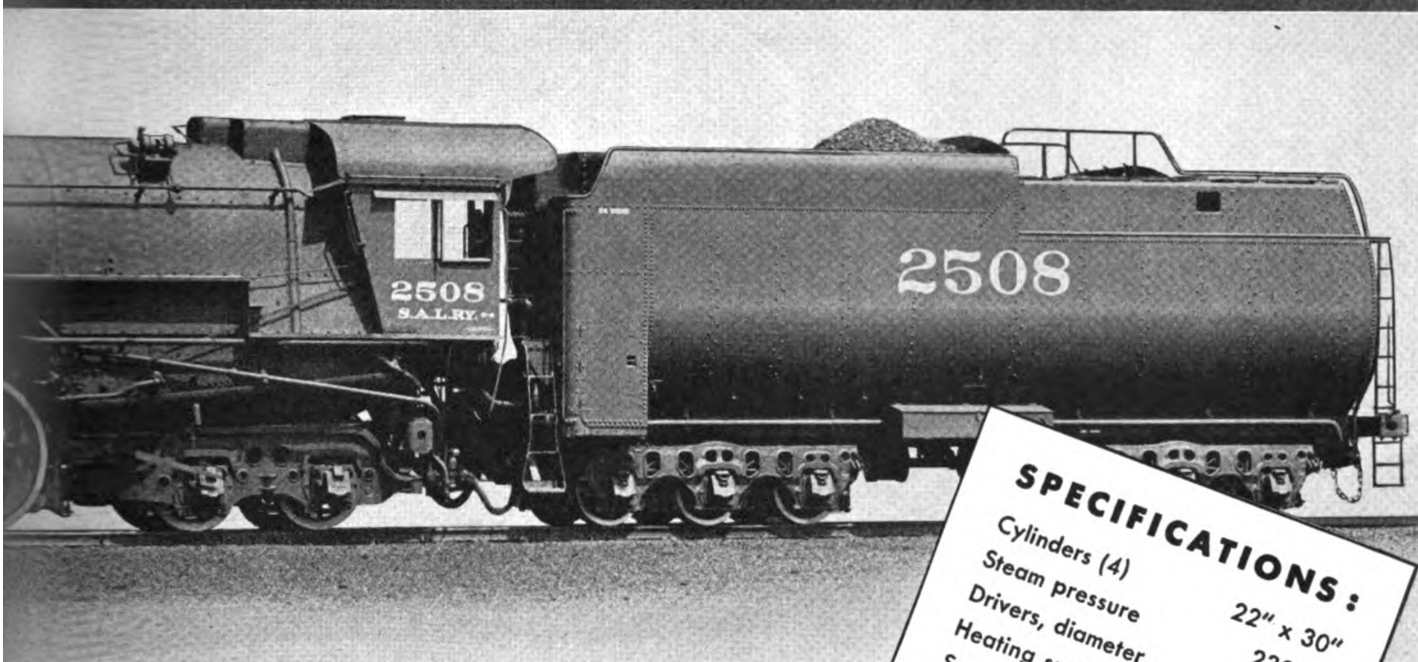
ECONOMICAL TO OPERATE—GM 600 H.P. 100-ton Diesel Switchers are operating at an hourly fuel cost as low as 18 cents — approximately 80 per cent less than for a comparable steam engine.

ECONOMICAL TO MAINTAIN—The Diesel Engine — the heart of the power plant — is especially designed for railway service. Individual injection units for each cylinder, uniflow 2-cycle with scavenging blower, a reliable pressure lubrication system — all of which contribute to dependable and economical performance. Furthermore, engine compactness permits maximum accessibility and simplifies inspections and running repairs.

ECONOMICAL TO SERVICE—GM Diesel Switchers frequently operate an entire week without refueling. Sanding is generally done during daily inspection. There is no expense or loss of engine-hours for taking water, ash pit cleaning or boiler washing.

ELECTRO-MOTIVE CORPORATION
SUBSIDIARY OF GENERAL MOTORS
LA GRANGE, ILLINOIS, U.S.A.

GETS REPEAT ORDER



RAILWAY

SPECIFICATIONS:

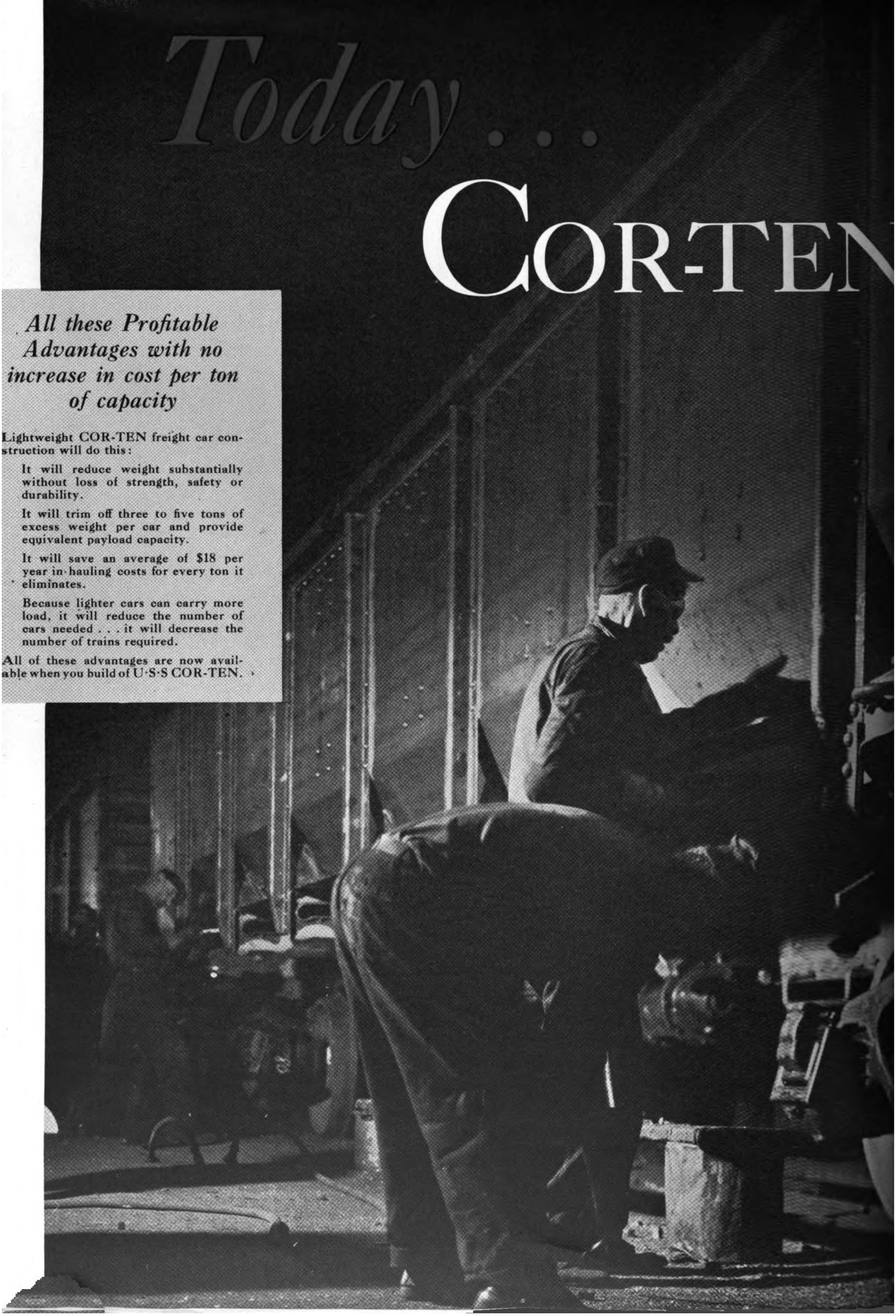
Cylinders (4)	22" x 30"
Steam pressure	230 lb.
Drivers, diameter	69"
Heating surface	5429 sq. ft.
Superheating surface	2397 sq. ft.
Weight on drivers	330,000 lb.
Weight, total eng.	480,000 lb.
Weight, engine and tender	793,800 lb.
Tractive force	82,300 lb.

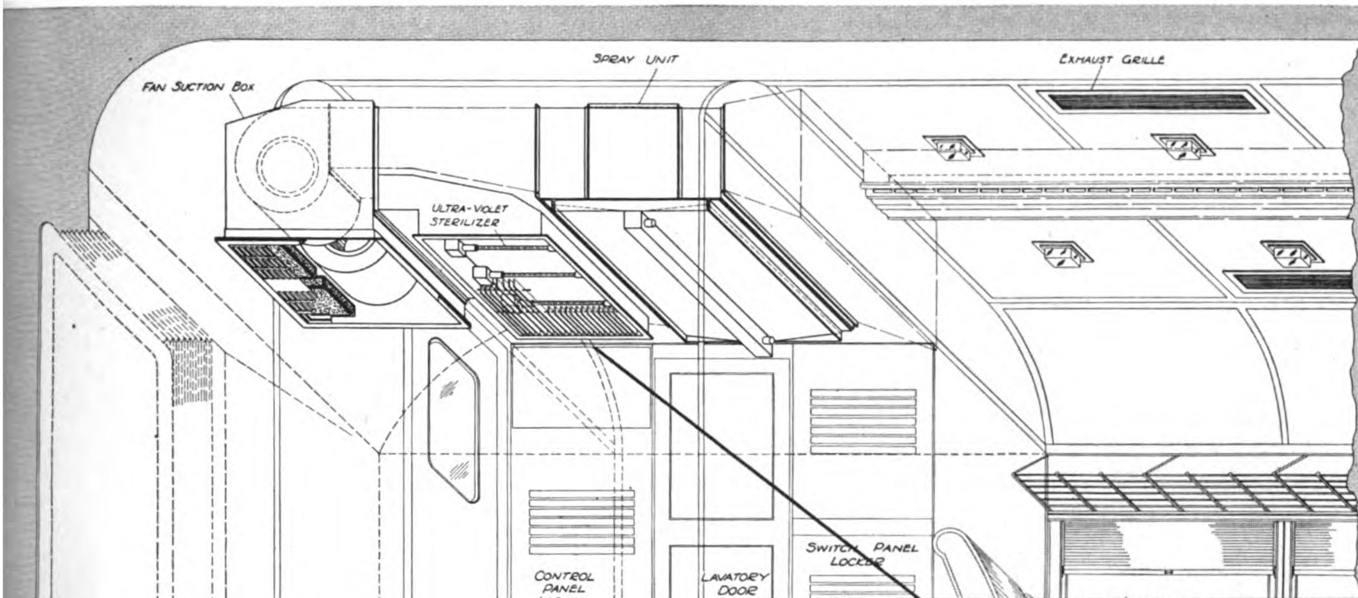
For more than two years, the first five locomotives, class R-1, have been operating in regular scheduled freight service on the 254-mile run between Richmond and Hamlet. They have also been used successfully to handle heavy passenger trains at high speed.

The proof of their efficiency lies in the repeat order for five locomotives, class R-2, which are practically duplicates. These are now going into the same service.

It takes Modern Locomotives to make money these days!

WORKS • • • PHILADELPHIA


Today . . .
COR-TEN
All these Profitable Advantages with no increase in cost per ton of capacity
Lightweight COR-TEN freight car construction will do this:
It will reduce weight substantially without loss of strength, safety or durability.
It will trim off three to five tons of excess weight per car and provide equivalent payload capacity.
It will save an average of $18 per year in hauling costs for every ton it eliminates.
Because lighter cars can carry more load, it will reduce the number of cars needed . . . it will decrease the number of trains required.
All of these advantages are now available when you build of U·S·S COR-TEN.



ADVANTAGES OF STURTEVANT SPRAY TYPE UNITS WITH ULTRA-VIOLET RAY

When Sturtevant "Railvane" Spray Type Units are used in connection with ice, Freon, or steam jet systems, all the advantages of standard air conditioning are made available—plus the additional advantages of:

1 Mellowed air—no sensation of *sharp-cold* and *shock* to passengers.

2 Elimination of dust and odors from air in the summertime, by washing.

3 No odors in the wintertime from offensive accumulations on cooling surface, since main cooling coils are entirely omitted.

4 If desired, the spray units can be used in mild or hot, dry, dusty weather as Evaporative Coolers—to freshen and cool the car with 100% washed outside air without the use of refrigeration. Therefore, operating costs are reduced.

5 Sprays, when in operation, not only free the air of dust, but also remove bacteria and other micro-organisms.

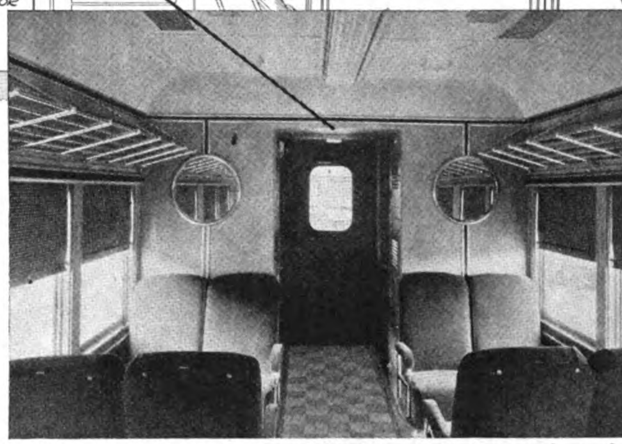
6 **In the winter, when the sprays are shut down, ultra-violet rays having great sterilizing power are substituted for the sprays as protection against bacteria and other micro-organisms.**

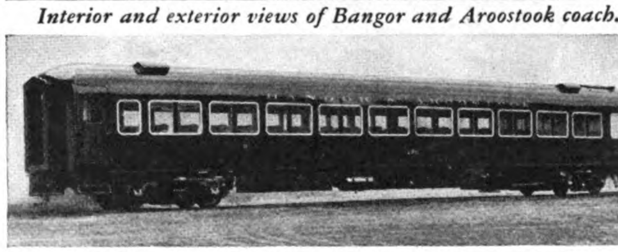
7 **Water sprays humidify without window condensation.**

8 **Water sprays act as stabilizing influence on temperature and humidity, regardless of passenger load and other heat load influences.**

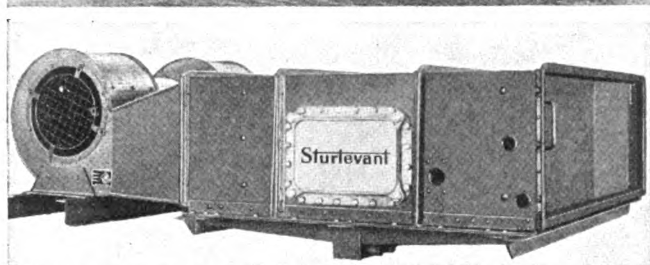
9 **Uncertainty of temperature and humidity conditions, ordinarily caused by laxity in making proper control settings, greatly reduced.**

10 **Only *slightly* higher in cost over conventional coil type units.**





Interior and exterior views of Bangor and Aroostook coach.



Sturtevant "Railvane" Spray Type Air-Conditioning Unit.

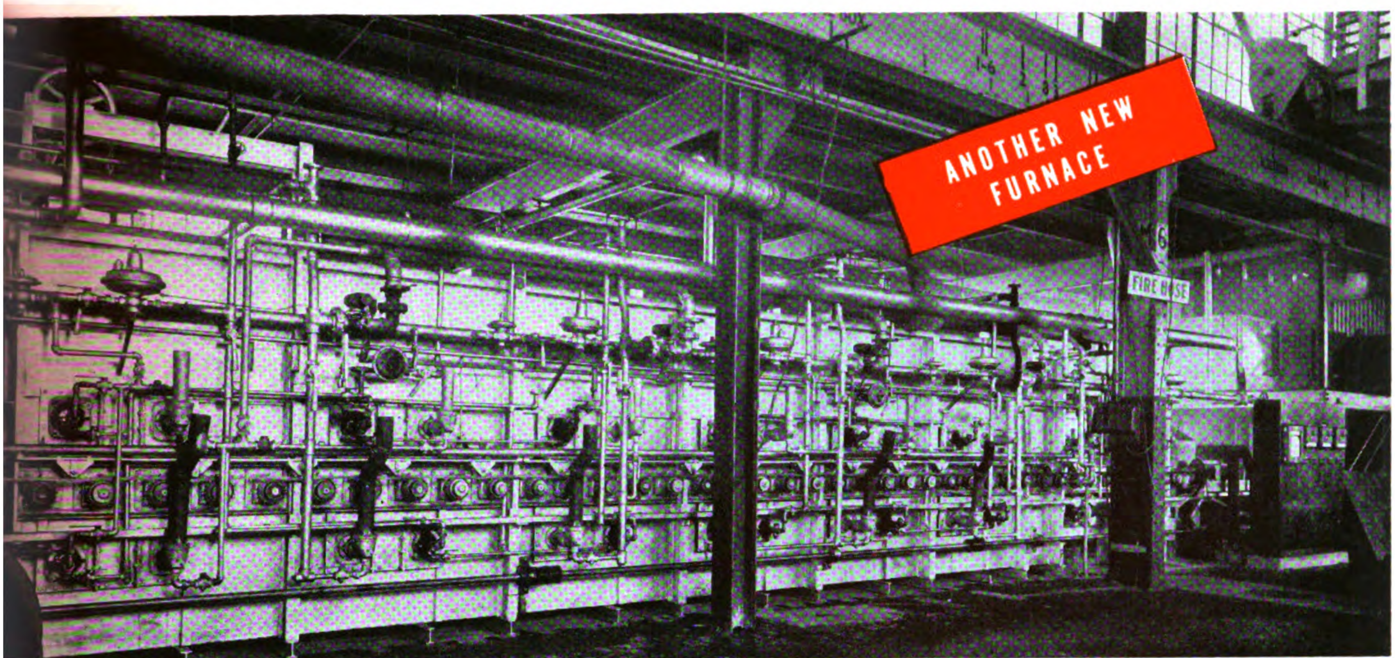
Sturtevant RAIL VANE TRADE MARK

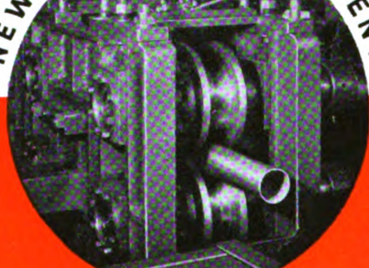
Sturtevant "Railvane" Units or Systems are used by 37 railroads. "Railvane" Air Conditioning is protected by 30 issued patents and other patents pending.

B. F. STURTEVANT COMPANY, HYDE PARK, BOSTON, MASS.

Branches in 40 Cities • B. F. Sturtevant Company of Canada, Ltd. Galt, Toronto, Montreal


ELECTRUNITE
REG. U.S. PAT. OFF.
STEEL & TUBES ELECTRIC WELD
BOILER TUBES
IN 1936
STILL GROWING
making more Electrunite Boiler Tubes than ever before
...and making them better
REPUBLIC STEEL
Steel and Tubes Inc.
WORLD'S LARGEST PRODUCER OF ELECTRICALLY WELDED TUBING
CLEVELAND . . . OHIO
ELECTRUNITE
BOILER TUBES
. . . AND IN 1937
EVEN GREATER GROWTH





Again, it has been necessary to increase capacity to meet the rapidly growing demand for ELECTRUNITE Boiler Tubes. Another, larger, controlled atmosphere annealing furnace has been added. The end of the finishing building built in 1936 has been removed and the building increased in length. New welding equipment has been installed. And even with this increase in capacity, every unit must operate at full time to keep pace with orders.

There must be a reason . . . and this is it: Only by cold forming, electric resistance welding and controlled atmosphere annealing is it possible to produce boiler tubes with the unequaled consistent uniformity that makes ELECTRUNITE Boiler Tubes safe, sound and economical.

Let us tell you more about ELECTRUNITE Boiler, Condenser, Heat Exchanger and Air Preheater Tubes.

SUBSIDIARY OF REPUBLIC STEEL CORPORATION

Steel and Tubes, *Inc.*

WORLD'S LARGEST PRODUCER OF ELECTRICALLY WELDED TUBING

CLEVELAND . . . . OHIO

When writing Steel and Tubes for further information, please address Dept. RG

REVENUE MILES FROM YOUR TRAILER TIRES

G-E Electric Ovens Expand the Tires for Fitting without Destroying Any of the Metal Characteristics

IT's no wonder that extensive shelling of treads often occurs on the trailer tires of fast, heavy locomotives. The wearing conditions are severe!

To reduce excessive shelling, many roads are adding strength to the tire metal by the tempering and quenching process. When such tires are heated for application to the wheel centers, special precautions must be taken to preserve the characteristics of the heat-treated metal. Since destructive temperatures occur before visible red heat, a method of accurately controlled tire heating must be used in the subvisible range.

G-E Oven in a Locomotive Plant

When a railroad specifies heat-treated trailer tires, one progressive locomotive builder protects the customer's original investment by using a G-E electric tire-expanding oven of the two-compartment, box type. Each compartment holds two tires and is equipped with individual thermostatic control for 500 F, plus or minus 10 degrees. One hour per inch of thickness provides a uniform heat up to the desired temperature. Once the desired temperature is attained, the accurate thermostatic control and the well-insulated case combine to hold the heat indefinitely at little added power consumption.

In Your Own Wheel Shop

When your old trailer tires wear out, why not be as exacting in your replacement work as the locomotive builder? A G-E oven installed in your shop will eliminate the guesswork in the heating of tires. Its accuracy of heat control will assure complete retention of the properties gained from the heat treatment, and will prevent the setting up of mechanical stresses in the metal. Your plain carbon-steel tires for driving wheels, though not so exacting in temperature requirements, can be heated uniformly in the same oven.

In its 20 years of experience as a builder and user of electric heat-treating equipment, General Electric has solved for its customers and for itself many perplexing problems of design and operation. This experience is incorporated into the G-E electric oven to give you years of trouble-free, economical service. For added information, write General Electric Company, Schenectady, New York.

GENERAL ELECTRIC

96-370

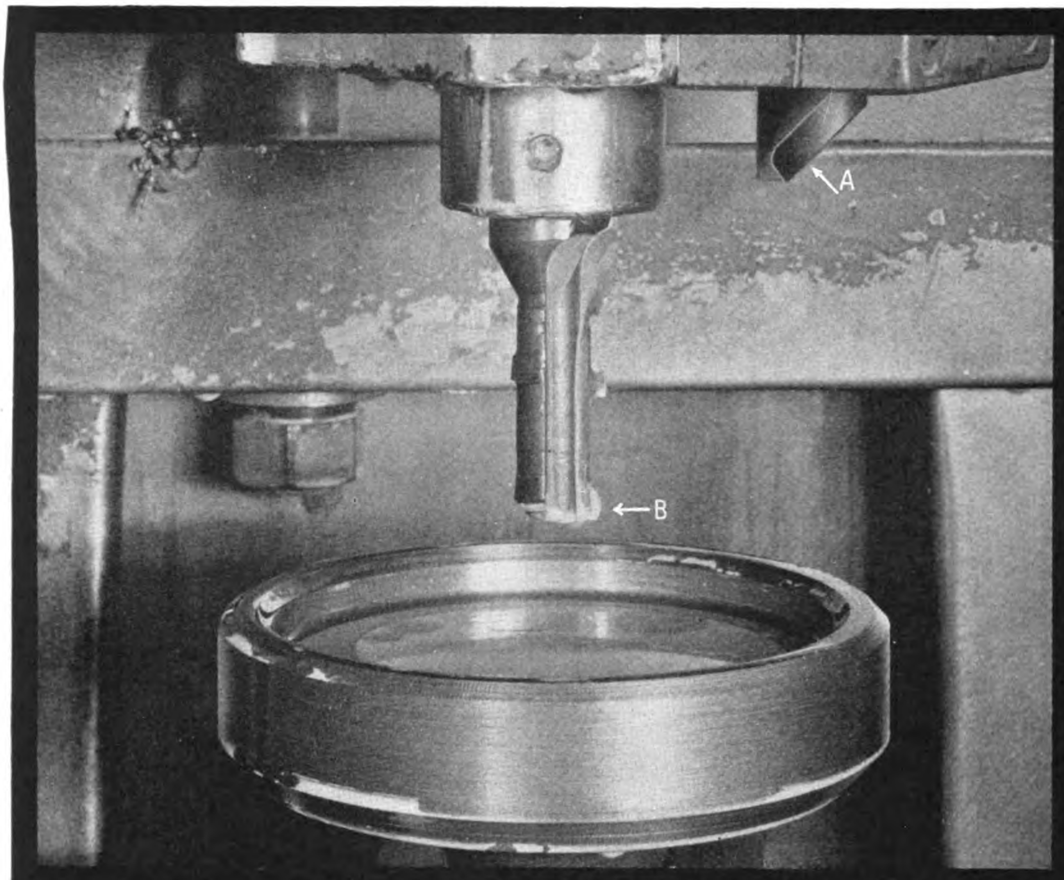


Photo. Courtesy Buick Motor Company

VASCOLOY-RAMET BLANKS

Vascoloy-Ramet is available in three forms, (a) completely finished tools, (b) milled and brazed tools, and (c) blanks. V-R blanks are furnished in 5 standard styles and in sizes to meet every requirement. To make tools with V-R blanks is a simple operation, fully described in a new instruction booklet, available free—upon request.

*Machining operation on driving unit involving multiple diameters. Material: Forging S.A.E. 4640, Brinell 187-207. Operations: Chamfer I.D. 4.429" with V-R, Grade E, (**A** in photograph) while boring double diameter (.740"-.790") with H.S. Steel (**B** in photograph). Performance of V-R, Grade E:*

Tool Material	Feed	Depth of Cut	Speed	Pieces per Grind
V-R Grade E	.0035"	1/8	340 S.F.M.	800

Every shop man knows the problem involved in machining multiple diameters in a single operation.

Here, again, Vascoloy-Ramet, the tantalum carbide tool material, demonstrates its superiority as a time and money saver, by its efficient operation at the high speed (340 S.F.M.) on the 4.429" diameter necessitated by a satisfactory boring speed on the .740" diameter.

Produced in 17 standard grades of different tantalum carbide content, strength and hardness, V-R alone covers the entire range of machinable materials and machining needs.

It is unrivaled in the machining of all steels from the softest to the toughest alloys. Its performance on cast iron, semi-steel and non-ferrous metals is exceptional.

"A Grade for Every Use" may be the solution to the machining problems in your plant. Send for the V-R Catalog price list.

VANADIUM-ALLOYS STEEL CO.
VASCOLOY-RAMET DIVISION, NORTH CHICAGO, ILL.

VASCOLOY-RAMET

... The TANTALUM CARBIDE TOOL MATERIAL ...

A GRADE FOR EVERY USE

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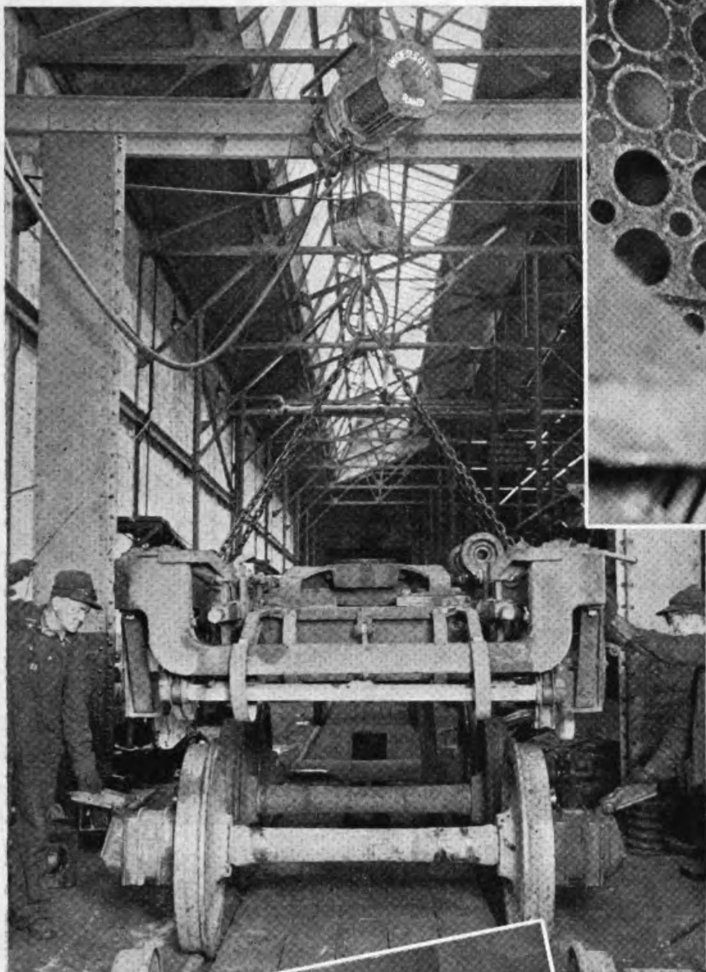
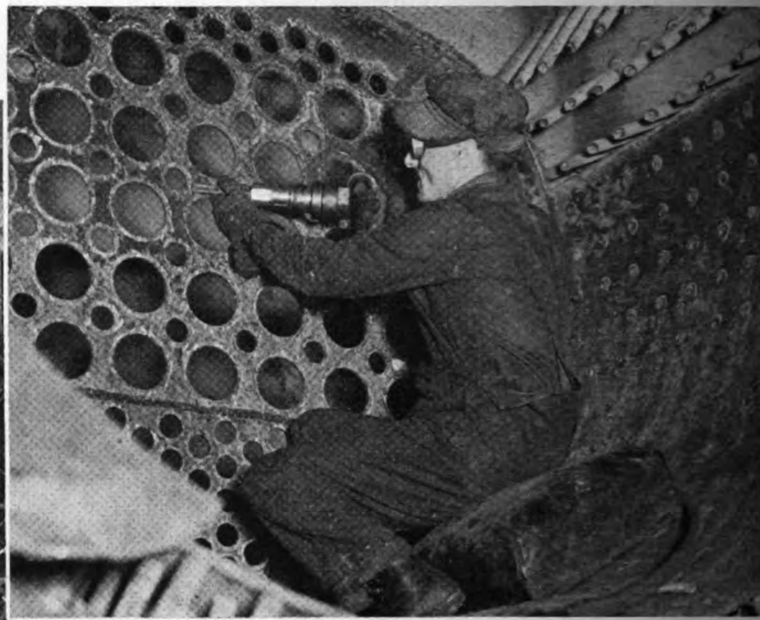
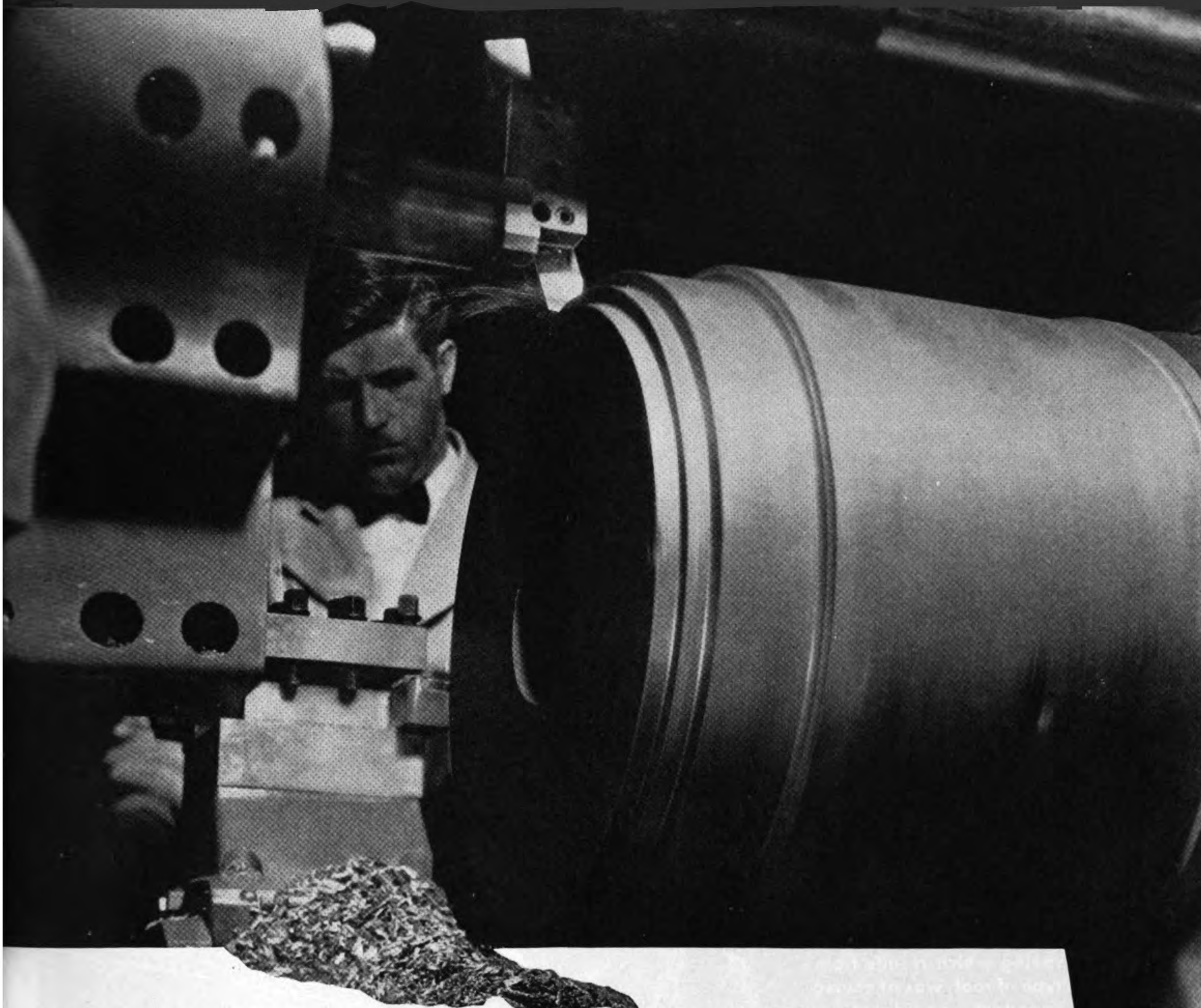






Drive Rail Lag Screws

FASTER—AT LOWER COST

DRILLING LEAD HOLES for rail lag screws with the Black & Decker 3/4 - inch Heavy Duty Drill. Power is supplied by a portable gasoline - driven motor generator.

DRIVING RAIL LAG SCREWS with a battery of Black & Decker No. 81 Lag Screw Drivers, for anchoring tie - plates firmly to cross - ties to prevent creeping.

ON THE RIGHT-OF-WAY and in the round-house, in the shops and on construction jobs—Black & Decker Portable Electric Tools are cutting costs and speeding up construction, maintenance and repair operations. Black & Decker manufactures a complete line of Portable Electric Tools—for use on standard AC and DC Voltages for all types of railway use. Ask your Black & Decker Jobber or write for details today. The Black & Decker Mfg. Co., 747 Pennsylvania Avenue, Towson, Maryland.

Black & Decker

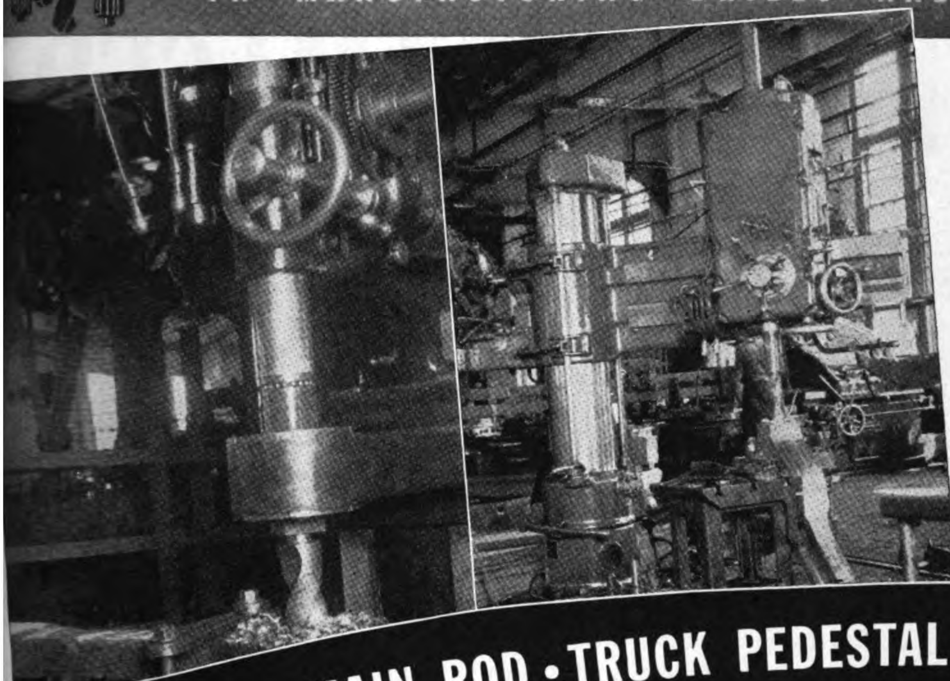
World's Largest Manufacturer of

BLACK & DECKER

PORTABLE ELECTRIC TOOLS

PROGRESS

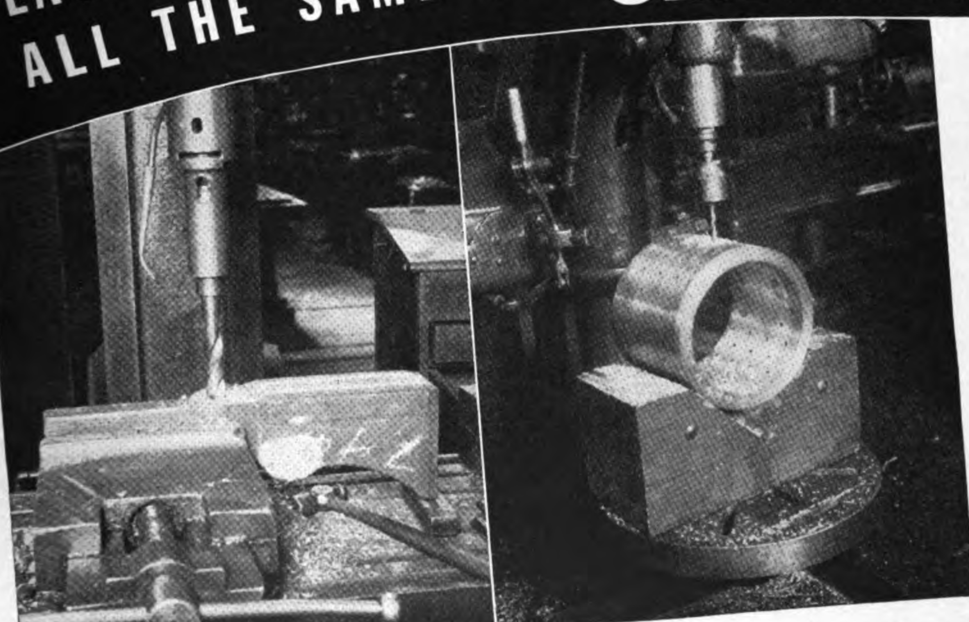
IN MANUFACTURING DRILLS AND REAMERS



★ Drilling a drawbar correctly takes a well-trained mechanic and an equally dependable tool in the spindle.

★ There's where "Cleveland" Twist Drills come in—there, and in many other important operations that govern the power, speed and safety of engines that pull trains.

DRAW BAR • MAIN ROD • TRUCK PEDESTAL • BRASS BUSHING
EACH A "*Different*" DRILLING OPERATION BUT
ALL THE SAME TO "CLEVELAND"!



★ In their outstanding programs of modernizing for better, faster and lower-cost transportation of passengers and freight, many important roads have bought heavily of "Cleveland" Tools to reduce costs at the logical beginning point.

★ If you are not already using "Cleveland" Tools, why not set them to work on one of your toughest jobs? A Representative from nearby will gladly cooperate.

The **CLEVELAND TWIST DRILL COMPANY**
1242 EAST 49th STREET
CLEVELAND

TRADE MARK REG. U S PAT OFF AND FOREIGN COUNTRIES

30 READE ST. NEW YORK — 9 NORTH JEFFERSON ST. CHICAGO — 654 HOWARD ST. SAN FRANCISCO
6515 SECOND BLVD., DETROIT — LONDON - E. P. BARRUS, LTD.- 35-36-37 UPPER THAMES ST., E.C.4

"CLEVELAND" DISTRIBUTORS EVERYWHERE ARE READY TO SERVE YOU

Greetings

Merry Christmas!
Happy New Year!

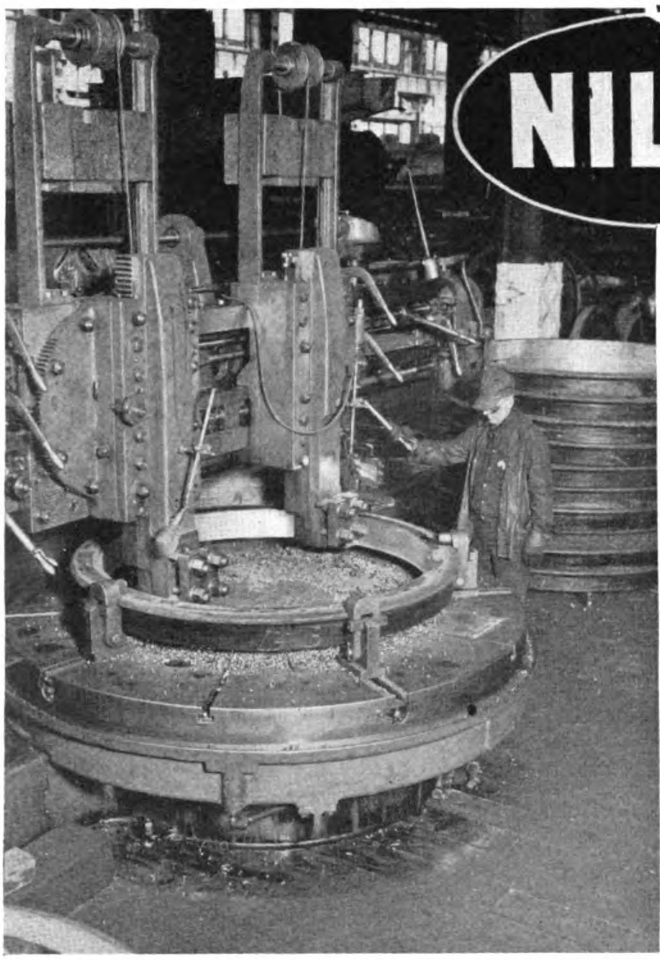
What a happy arrangement, to have Christmas just before New Year's Day! Christmas is the time to "square accounts" for the year so nearly gone. Disappointments and discouragements are swept away by the flood tide of Good Cheer at Christmas. It brings new Hope and Confidence for the New Year.

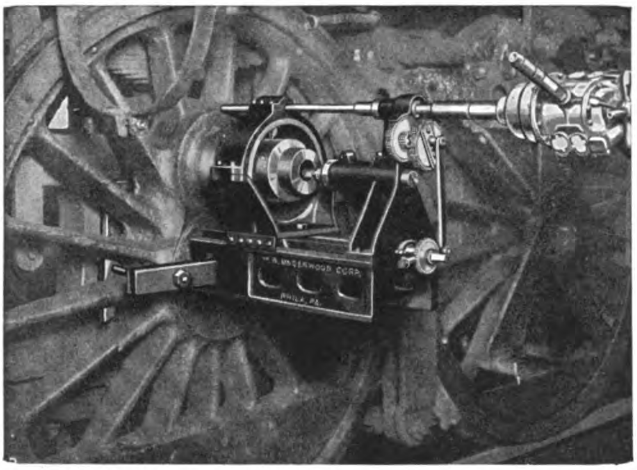
This festival of Good-Will gives us occasion to express gratitude for countless friendships, and for the many opportunities given us to serve. May the New Year bring Peace, Happiness and Abundance to all!

The J. B. Ford Company

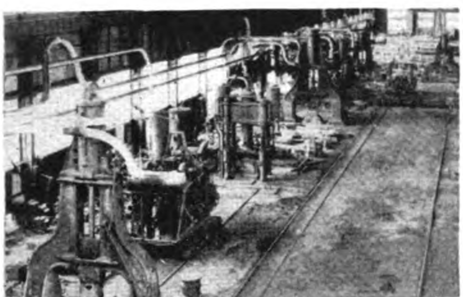
WYANDOTTE • MICHIGAN

Wyandotte
PRODUCTS





A DIFFERENT BREED of CATS...

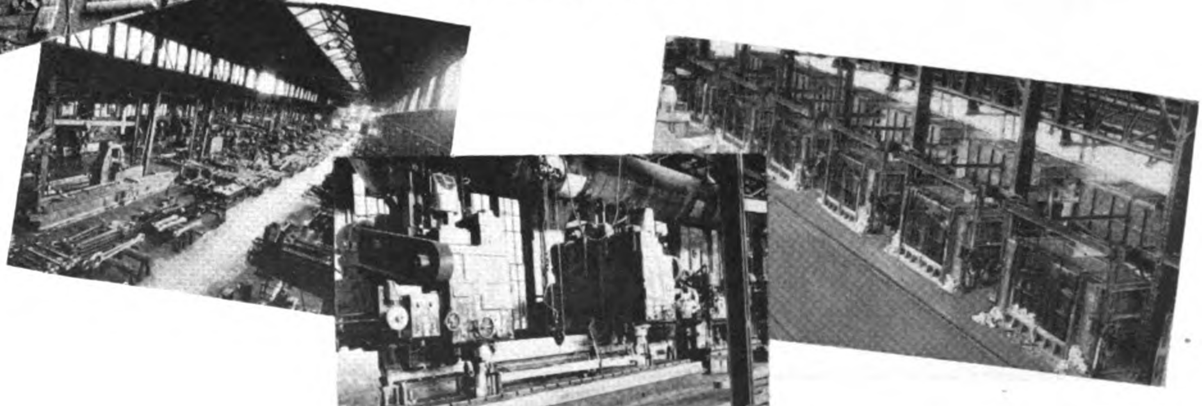


YOU cannot throw the manufacture of light-weight alloy steel forgings into the ordinary forge shop. They've got to be handled entirely differently. They're a different "breed of cats". A new manufacturing set-up is necessary—the purchase of a wide variety of particular equipment becomes imperative—the training of a special personnel essential.

Alco has this set-up, experienced and proved competent.

Why should a railroad make large capital expenditures to duplicate Alco's facilities, train a special personnel, and then work it only part time?

Alco is fully equipped in every respect to make prompt delivery, and economically as well as satisfactorily fulfill your requirements.



ALCO

AMERICAN LOCOMOTIVE COMPANY

30 CHURCH STREET · NEW YORK · N · Y

High Wheels—High Pressures—High Speeds

Lehigh Valley high-pressure locomotive, equipped with King metallic packing on piston rods, valve stems, and reverse gear pistons, and with King sanders.

A POSITIVE grip on the rail and a quick get-away while hauling heavy trains is characteristic of modern high power locomotives.

KING Sanders are a necessary adjunct to locomotives of this type. Due to their simplified design they deliver the desired amount of sand to the rail regardless of the weather.

There are no air nozzles lying in the sand to become clogged or worn in KING Sanders. They require very little attention and are exceptionally low in maintenance.

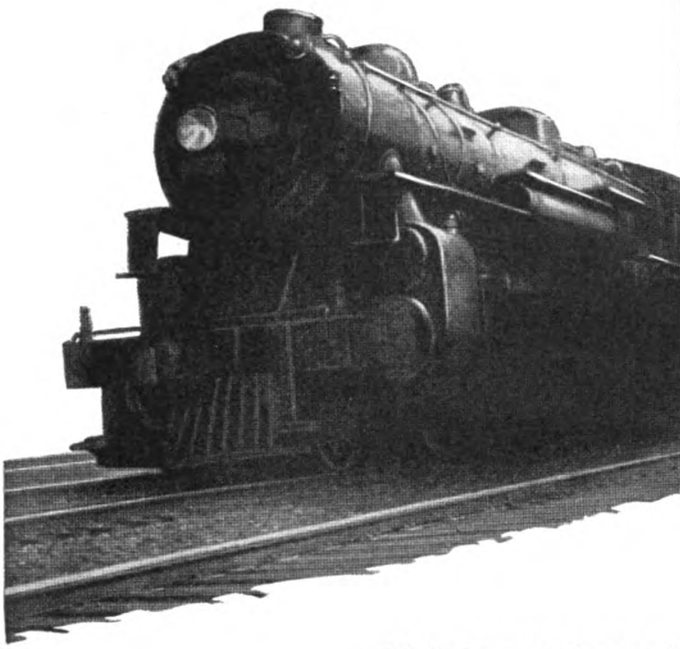
KING Sanders may be applied to locomotives of all types, steam, oil or electric, with money saving results.

THE U. S. METALLIC PACKING CO.
PHILADELPHIA PENNSYLVANIA
Representative in Canada, Joseph Robb & Company, Limited, Montreal.

KING PRODUCTS

King Metallic Packing • King Mechanical Lubricator • McLain Cylinder Cock • King Sander

LUNKENHEIMER
A.A.R. VALVES
for
Locomotives



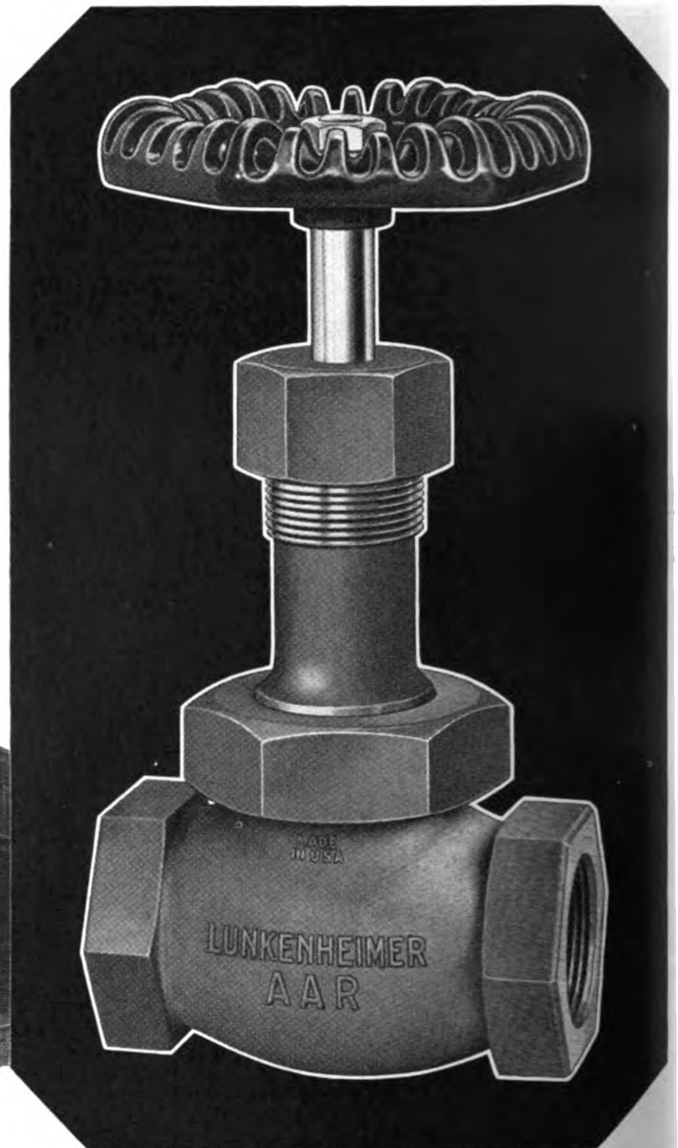


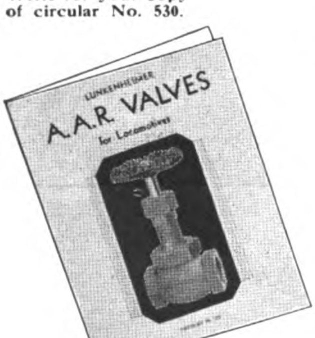
Fig. 1890
Inside Screw

Made in accordance with A. A. R. specifications, these valves also embody the quality features characteristic of all Lunkenheimer products. Carefully selected raw materials, precision workmanship and rigid testing procedure are reasons why Lunkenheimer A. A. R. Valves so successfully withstand the severity of locomotive service.

Available in inside and outside screw patterns, globe and angle, and with male or female inlet, union outlet connections. All patterns are made in both full-way and plug type.

Fig. 1896
Outside Screw

Write for your copy of circular No. 530.



THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO. U. S. A.
NEW YORK CHICAGO
BOSTON PHILADELPHIA
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

Buy QUALITY–Buy LUNKENHEIMER

1-82-75

THEY TOOK NO CHANCES

when selecting boiler tubes

for the New Haven's 10 New Streamliners

ADVANTAGES OF NATIONAL SEAMLESS BOILER TUBES

Seamless—no uncertainty about full wall strength in every tube.

Higher creep strength — only "killed" open-hearth and electric-furnace steels used.

Uniform density and soundness — improved heat transfer characteristics.

Exceptional ductility — every tube annealed from end to end — can be bent, expanded, flanged, beaded, and rolled without splitting or fracture.

Thorough uniformity assured by careful metallurgical supervision.

More than 45 years of satisfactory performance in railroad service.

Comply with all recognized specifications for water-tube or fire-tube boilers.

THESE high-speed locomotives are the last word in steam-traction design. Their construction means improved service, lower operating costs, and less maintenance expense on the important run between Boston and New Haven. Boiler tubes, superheater tubes, superheater flues — 100% NATIONAL Seamless.

Builders of these locomotives gave just as serious thought to the selection of boiler tubes as they gave to the selection of traction equipment. These men know that there can be no compromise with quality in the heart of the locomotive. Extensive tests confirmed their experience. And they selected NATIONAL Seamless.

NATIONAL Seamless Boiler Tubes are safe—they are pierced from billets of solid steel, which means uniform wall strength throughout. In more than 45 years of lasting, trouble-free service, they have proved their ability to stand up under high pressures—to minimize replacements and cut repair bills.

For tubing and retubing, take a tip from leading locomotive builders — NATIONAL Seamless Boiler Tubes.

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

INDEX TO ADVERTISERS

DECEMBER, 1937

December 1937

Railway Mechanical Engineer

FOUNDED IN 1832

Reliance HY-CROME *Spring Washers*

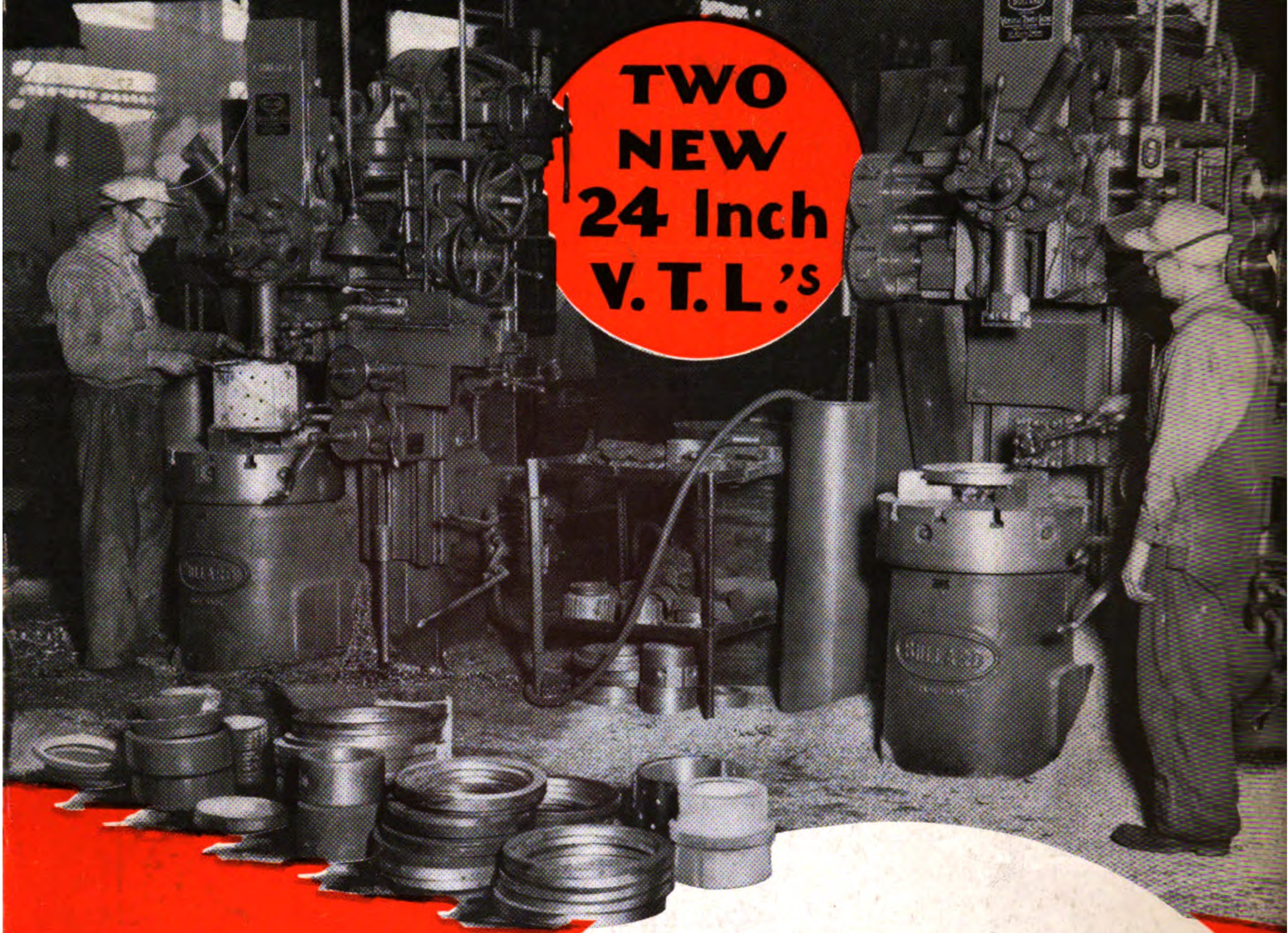
RELIANCE LOCOMOTIVE HY-CROME *Spring Washers* furnish the reactive spring pressure necessary to maintain the desired bolt tension bridging maintenance periods — thereby compensating for looseness and reducing wear from loose parts. Wear is inevitable — retard and prevent it; keeping motive power in continuous service is a step to increased profits and reduced costs. There are no substitutes for LOCOMOTIVE HY-CROME *Spring Washers*.

One of the new locomo-tives of the New Yor New Haven and Hartfor Railroad — modern in ever respect—completely equipp with LOCOMOTIVE HY CROME *Spring Washers*.

EATON MANUFACTURING COMPAN
RELIANCE SPRING WASHER DIVISIO
MASSILLON, OHIO

LOCOMOTIVE HY-CROME

PREVENTS BOLT LOOSENESS



Just Installed
—*And Are They Busy?*

ROD bushings—valve packing rings—rod liners and a score of other small locomotive parts keep these two new 24" BULLARD'S busy saving money for the railroad.

Selection was based not only upon economical production, but also the versatility of the Vertical Turret Lathe and its multiple tooling and multiple cutting features.

Vertical Turret Lathe methods are nearly standard in railway shops. Economical production is, of course, the outstanding factor but the general all-around utility features which make BULLARD'S practically indispensable are additional reasons why you find them in the small shops as well as the large centralized repair plants.

An investment in BULLARD'S has always been refunded in a year or two—time, of course, depending upon their use.

VERTICAL TURRET LATHES
are available in the following sizes:
24"—36"—42" and 54"

THE BULLARD COMPANY
BRIDGEPORT, CONNECTICUT